Public understanding of global climate change in Malawi: An investigation of factors influencing perceptions, attitudes and beliefs about global climate change

by

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Dissertation presented for the Degree of Doctor of Philosophy in the Faculty of Arts and Social Sciences at Stellenbosch University

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March 2015

Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own original work, that I am the authorship owner thereof (unless to the extent explicitly otherwise stated) and that I have not previously submitted it, in its entirety or in part, for obtaining any qualification.

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March 2015

Abstract

This study is informed by both the deficit/positivist and contextual/critical models for doing public understanding of science (PUS) research and seeks to investigate factors that influence the perceptions, beliefs and attitudes towards climate change in Malawi. Previous research on the public understanding of climate change conducted in the United States of America (USA) and Europe suggest that people's beliefs, perceptions and attitudes do influence support for both voluntary and policy initiatives to address climate change and adaption to it. However, it is equally important to understand the factors that influence public perceptions, beliefs and attitudes towards climate change. An investigation into these factors provides an understanding and appreciation of the contextual issues related to the public assimilation and renegotiation of climate change information, as well as the support or rejection of initiatives aimed at addressing climate change.

Sub-Saharan African countries are most vulnerable to the effects of climate change because their national economies and populations depend on rain-fed agriculture. Malawi is no exception. The majority of the Malawian population (at least 85%) live in rural areas and depend on subsistence, rain-fed agriculture for their livelihood, and are therefore more vulnerable to climate change. Furthermore, Malawi's economy is agro-based (agriculture comprises about 36% of the Gross Domestic Product (GDP), 85% of exports earnings and 84% of total employment). On the basis of these facts, I hypothesised that the perceptions, beliefs and attitudes of Malawians towards climate change are influenced by a wide range of factors, including the impact of climate change on livelihoods. More specifically, I proposed that more rural inhabitants than urban residents were likely to agree that their livelihood has been negatively affected by climate change, and would also be more willing to take voluntary action to address climate change.

Upon performing chi-square analyses of the responses, the results indicate that: (i) significantly more rural (91%) than urban inhabitants (51%) agree that their livelihood has been negatively affected by climate change, and (ii) significant higher proportions of the rural population have at some point taken voluntary action to address climate change

Multinomial logistic regression models predicted the perceptions, beliefs and attitudes of Malawians towards climate change. The results show that location is the only predictor of whether an individual would agree that his/her livelihood has been negatively affected by climate change or not. Rural inhabitants are 6.5 times more likely than urban residents to agree that their livelihood has been negatively affected by climate change. Location is also a predictor of the belief that climate change and its impact is the will of God; the belief that the solution to climate

change rests with God; and how certain or uncertain a person is regarding the effects of climate change. Binary logistic regression results show that location is also the strongest predictor of whether an individual would take a voluntary action to address climate change or not. Rural inhabitants are 2.3 times more likely than urban residents to take voluntary action to address climate change.

Besides place of residence, other predictors of perceptions, beliefs and attitudes towards climate change are: level of education (predictor of three outcome variables, namely: how certain or uncertain a person is about the causes of climate change; whether an individual believes that climate change and its impact is the will of God or not; and whether an individual believes that the solution to the problem of climate change rests with God or not); environmental groups and institutions of learning as sources of information about climate change (predictors of how certain or uncertain a person is about the causes of climate change, and whether a person believes that climate change and its impact is the will of God or not, respectively); and the trustworthiness of village headmen as a source of information about climate change (predictor of whether an individual will believe that climate change and its impact is the will of God or not; and whether an individual will take personal initiative to address climate change).

These findings affirm the hypothesis that the impact of climate change on livelihoods of Malawians living in rural locations influences their perceptions, beliefs and attitudes towards climate change. Additionally, the findings suggest that public education about climate change remains key to promoting understanding of climate change. The Government of Malawi and non-governmental organisations have to take up this challenge of educating the Malawian public about climate change, particularly those living in rural locations. However, public education of climate change in Malawi demands that we also take into account the contextual factors that influence Malawians' perceptions, beliefs and attitudes towards climate change. For future research, the study suggests that more research in Sub-Saharan Africa is warranted to unearth the contextual factors that influence the public understanding of climate change.

Opsomming

Hierdie studie inkorporeer insigte uit onderskeidelik die tekortskietende/positiwistiese en kontekstuele/kritiese modelle rakende die openbare verstaan van wetenskapsnavorsing, in ’n poging om die faktore wat die persepsies, oortuigings en houdings teenoor klimaatsverandering in Malawi beïnvloed te ondersoek. Vorige navorsing oor die openbare begrip van klimaatsverandering – wat in die Verenigde State van Amerika (VSA) en Europa uitgevoer is – dui daarop dat individuele persepsies, oortuigings en houdings ’n invloed uitoefen op die ondersteuning vir beide vrywillige sowel as beleidsinisiatiewe in klimaatsverandering. Dit is egter van groot belang om die faktore wat openbare persepsies, oortuigings en houdings teenoor klimaatsverandering beïnvloed te verstaan. ʼn Ondersoek na hierdie faktore verskaf begrip sowel as waardering vir die kontekstuele kwessies wat verband hou met die openbare assimilasie en “heronderhandeling” van inligting oor klimaatsverandering. So ’n ondersoek dra ook by tot ’n verduideliking waarom voorgestelde klimaatsveranderingsinisiatiewe òf verwerp òf ondersteun word.

Lande in sub-Sahara Afrika, waaronder Malawi, is baie kwesbaar vir die gevolge van klimaatsverandering as gevolg van die aard van hul ekonomieë en die samelewing se afhanklikheid van nie-besproeiingslandbou. Die Malawiese bevolking is grotendeels landelik (ten minste 85%) en maak staat op nie-besproeiingsbestaansboerdery, wat hulle dus meer kwesbaar maak vir die gevolge van klimaatsverandering. Malawi se ekonomie is boonop landbou-gedrewe: landbou dra by tot ongeveer 36% van die BBP, tot 85% van inkomste uit uitvoere en tot 84% van totale indiensnemingsgetalle. Gegewe hierdie feite is my hipotese dat die persepsies, oortuigings en houdings van Malawiërs teenoor klimaatsverandering deur talle uiteenlopende faktore beïnvloed word, waaronder die impak van klimaatsverandering op hul daaglikse bestaan. Die hipotese suggereer verder dat meer landelike inwoners, in teenstelling tot stedelike inwoners, geneig sal wees om saam te stem dat hul bestaan negatief deur klimaatsverandering beïnvloed word, en derhalwe ook ’n groter gewilligheid sal openbaar tot vrywillige optrede wat klimaatsverandering aanspreek.

Chi-kwadraat analises wat op die opnameresponse uitgevoer is, dui daarop dat (i) meer landelike (91%) as stedelike (51%) inwoners saamstem dat hul bestaan negatief deur klimaatsverandering beïnvloed word en dat (ii) ʼn beduidende hoër persentasie landelike inwoners op een of ander stadium vrywillig teen klimaatsverandering opgetree het.

Multinomiale logistiese-regressiemodelle is gebruik om die persepsies, oortuigings en houdings van Malawiërs teenoor klimaatsverandering te voorspel. Die resultate toon dat ligging die enigste

betekenisvolle voorspeller is in die uitkoms of ŉ individu saamstem dat sy/haar bestaan negatief deur klimaatsverandering beïnvloed word of nie – dit is 6.5 keer meer waarskynlik dat landelike as stedelike inwoners sal saamstem dat hul bestaan negatief deur klimaatsverandering beïnvloed word. Ligging dien ook as ŉ betekenisvolle voorspeller in drie verdere uitkomste, naamlik die oortuiging dat klimaatsverandering en die impak daarvan die wil van God is, die oortuiging dat die oplossing vir klimaatsverandering by God berus en hoe seker of onseker ŉ individu van sy/haar oortuiging is met betrekking tot die gevolge van klimaatsverandering. Volgens ’n binêre logistiese-regressieanalise is ligging ook die sterkste voorspeller of ŉ individu vrywillig sal optree om klimaatsverandering aan te spreek, al dan nie. Dit is 2.3 keer meer waarskynlik dat landelike inwoners, in teenstelling met stedelike inwoners, vrywillig sal optree om klimaatsverandering aan te spreek.

Agesien van ligging het die volgende ook na vore getree as bykomende voorspellers van individue se persepsies, oortuigings en houdings teenoor klimaatsverandering: (i) vlak van opvoeding (voorspeller van drie uitkomste-veranderlikes: hoe seker of onseker ŉ persoon is oor die oorsake van klimaatsverandering; of ŉ persoon glo dat klimaatsverandering en die gevolglike impak die wil van God is al dan nie; en of ŉ individu glo dat die oplossing vir klimaatsverandering by God berus al dan nie), (ii) die twee bronne van inligting rondom klimaatsverandering, naamlik omgewingsgroepe en opvoedingsinstellings, wat dien as voorspellers van hoe seker of onseker ŉ individu is oor die oorsake van klimaatsverandering, en of ŉ persoon glo dat klimaatsverandering en die gevolglike impak die wil van God is of nie; en (iii) die geloofwaardigheid van stamhoofde as ŉ bron van inligting oor klimaatsverandering (voorspeller van of ŉ persoon sal glo dat klimaatsverandering en die gevolglike impak die wil van God is of nie en of ŉ individu persoonlike inisiatief aan die dag sal lê om klimaatsverandering aan te spreek).

Die bevindinge van die studie bevestig die voorgestelde hipotese dat die impak van klimaatsverandering op die bestaan van Malawiërs wat in landelike gebiede woon, ook hul persepsies, oortuigings en houdings teenoor klimaatsverandering beïnvloed. ŉ Verdere bevinding is dat openbare opvoeding oor klimaatsverandering ŉ sleutelrol in die bevordering van die begrip oor klimaatsverandering speel. Die uitdaging rus op die skouers van die Malawiese regering en nie-regeringsorganisasies om die Malawiese publiek, en veral diegene wat in landelike gebiede woon, oor klimaatsverandering op te voed. Die voorgestelde organisasies sal hulself egter nie van hul taak kan kwyt indien daar nie ŉ begrip is van die faktore wat Malawiërs se persepsies, oortuigings en houdings teenoor klimaatsverandering beïnvloed nie. Die studie beveel aan dat meer navorsing in sub-Sahara Afrika onderneem behoort te word om kontekstuele faktore wat die openbare begrip van klimaatsverandering beïnvloed, te identifiseer.

Acknowledgements

First and foremost, I thank the Almighty God for life and granting me the grace to complete the study.

I would also like to express my heartfelt gratitude to my supervisor Professor Johann Mouton. Thank you very much for believing in me and giving me an opportunity to be your student. Your timely and invaluable feedback has enabled me to finish the thesis. Thank you for your guidance and support, without which I would have given up in 2011 when my ideas for the research project were hazy.

I thank the staff at CREST, particularly Marthie van Niekerk, Dr Nelius Boshoff, Milandré van Lill, Lynn Lorenzen, Nigel Jansen and Melinda Rust for the moral and technical support. I also acknowledge some financial support I received from CREST towards my data collection exercise. Certainly, conducting fieldwork in Malawi would not have been possible without such support.

I am also profoundly thankful to the Chief Executive Officers of Blantyre, Zomba, Lilongwe and Mzuzu city councils, and the District Commissioners, Traditional Authorities (T/As), and village headmen from Blantyre, Zomba, Chikhwawa, Mulanje, Mangochi, Ntcheu, Lilongwe, Kasungu, Salima, Mzimba and Nkhata-Bay for granting me permission to conduct research in areas within their jurisdiction. I also thank all the Malawian citizens who voluntary participated in the study. My heartfelt thanks also go to my six fieldworkers, namely: Yamikani Chilingulo, Faithstone Chilizani, Kenneth Kalele, Mphatso Kasonya, Dominic Manchichi, and Frazer Mkwaila, for their commitment and insights during the entire data collection exercise.

Pursuing a doctoral degree at a South African university is very expensive. I hereby acknowledge the funding that was awarded to me by the Graduate School of Arts and Social Sciences to pursue my doctoral studies full-time at Stellenbosch University. I am also very grateful to the University of Malawi for granting me study leave and for providing extra funding for my final (fourth) year of my doctoral study.

I am also indebted to Fran Ritchie for her meticulous editorial work on the thesis which has greatly improved its readability. Fran's work entailed proofreading and language editing; therefore I take full responsibility for the factual and statistical errors contained in the thesis.

Last, but not least, I thank my beloved wife Grace for her support throughout this long academic journey. You have endured my absence, especially as I had to leave you soon after we wed in 2012, and again after Faith, our beautiful daughter, was born in July 2013. Thank you too for your constructive criticism and for editing some parts of the thesis. You are part of this achievement!

Note: Some parts of the thesis have been presented at two conferences, namely: The Social Sciences for Development Conference (30-31 October 2013, Stellenbosch University) and Climate Change and Water Trans-disciplinary Forum (28 November 2013, Stellenbosch University). I am grateful for the feedback that I got from the conference attendees.

Dedication

In loving memory of my late mother, Dorothy Bakuwa, for encouraging me to work hard at school.

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List of Abbreviations and Acronyms

AAAS	American Association for the Advancement of Science
AIDS	Artificial Immunodeficiency Syndrome
BBC WST	British Broadcasting Corporation World Service Trust
CASW	Council for the Advancement of Science Writing
CFCs	Chlorofluorocarbons
CEC	Commission of the European Communities
CoPUS	Committee for Public Understanding of Science
CO_2	Carbon dioxide
CREST	Centre for Research on Evaluation, Science and Technology
CUDOS	Communism, Universalism, Disinterestedness, Originality and Scepticism
DC	District Commissioner
DSP	Dominant Social Paradigm
EAD	Environmental Affairs Department
ESRC	Economic and Social Research Council
EU	European Union
GDP	Gross Domestic Product
GVH	Group Village Headman
HIV	Human Immunodeficiency Virus
IEA	International Energy Agency
IFPRI	International Food Policy Research Institute
IGCSE	International General Certificate of Secondary Education
IPCC	Intergovernmental Panel on Climate Change
JCE	Junior Certificate of Education
MAFF	Ministry of Agriculture, Food and Fisheries
MDGs	Millennium Development Goals
MIT	Massachusetts Institute of Technology

MK	Malawi Kwacha
MSCE	Malawi School Certificate of Education
NAPA	National Adaptation Programmes for Action
NASW	National Association of Science Writers
NEP	National Environmental Policy
NEP	New Environmental Paradigm
NORC	National Opinion Research Center
NSF	National Science Foundation
NSO	National Statistical Office
PCA	Principal Components Analysis
PSLCE	Primary School Leaving Certificate of Education
PUS	Public Understanding of Science
SPSS	Statistical Package for Social Sciences
SSK	Sociology of Scientific Knowledge
STS	Science and Technology Studies
T/A	Traditional Authority
UK	United Kingdom
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFCC	United Nations Framework Convention on Climate Change
US$	United States dollar
USA	United States of America
VBN	Value-belief-norm
WW II	World War II (or Second World War)

CHAPTER 1

INTRODUCTION

"Climate change is an all-encompassing threat, directly affecting the environment, the economy, health and safety. Many communities face multiple stresses with serious social, political and security implications, both domestically and abroad. Millions of people are uprooted or permanently on the move as a result. Many more millions will follow" (Kofi A. Annan, President of the Global Humanitarian Forum, 2009).

1.1 Background

This study seeks to identify and explain factors influencing perceptions, beliefs and attitudes towards global climate change[1] in Malawi.

Arguably, global climate change—primarily caused by emissions of carbon dioxide and other greenhouse gases, as well as land use—is one of the most daunting challenges facing humanity today in the 21st century (IPCC Fifth Assessment Report (AR5), 2013). In fact, it is a major threat to sustainable development and achievement of Millennium Development Goals (MDGs) (Africa Partnership Forum, 2009). Being an all-encompassing challenge, global climate change directly affects the environment, economy, health and safety (Global Humanitarian Forum, 2009). Most developing countries are especially vulnerable to climate change impacts because they have agro-based economies and people's livelihoods are dependent on rain-fed agriculture. Vulnerability to climate change is viewed from two angles: vulnerable to the physical changes brought about by climate variability; and socioeconomic

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[1] Global climate change refers to changes in the geophysical and ecosystem as a result of emission of greenhouse gases, principally carbon dioxide, but also methane, chlorofluorocarbons (CFCs) and nitrous oxide into the atmosphere causing greenhouse effect (see Kempton, 1991, 1997). The terms 'global climate change' and 'global warming' are sometimes used interchangeably. However, global warming is not a synonym for global climate change. 'Global warming' to a lay person, without further elaboration simply means 'hotter weather'. Indeed, scientists and policy-makers use the term 'global climate change', while 'global warming' is the term that is mostly used by the media and lay people (Kempton, 1991; Leiserowitz, 2007; Corbett & Durfee, 2004; Whitmarsh, 2009). In this study I will use the scientifically correct terminology of 'global climate change.' By "public understanding of climate change" I mean the perceptions, beliefs and attitudes various sections of the public across the globe have about climate change. This may imply that the public lacks basic scientific facts about climate change; however, this may also mean that they do possess other forms of knowledge about climate change. In this thesis, by "understanding of climate change" I mean a person's ability to cognitively explain the basic facts about climate and climate change.

vulnerability as people attempt to adapt to the impacts of climate change. It is estimated that over 2.8 billion people are physically vulnerable to climate change while 4 billion people (60% of the world's population) are vulnerable to climate change and variability in socioeconomic terms (Global Humanitarian Forum, 2009). Perhaps, it is fair to assert that the world's developing countries are the most affected by climate change, although they are the least responsible for causing it (Global Humanitarian Forum, 2009; British Broadcasting Corporation World Service Trust (BBC WST), 2010).

Global climate change is a global environmental problem and requires global cooperation for its solution (Grundmann, 2007). The issue has attracted serious international attention particularly since the late 1980s. Two reasons can be given; firstly, during this period climate scientists established a correlation between human activities and climate variability, and scientists rightly sounded a warning to humanity that these human activities pose a serious threat to the future of both human and non-human lives. Secondly, during this period most national governments—because some media dramatized the issue of global climate change, labelling it as "climate catastrophe"— began to recognise global climate change as a policy problem, and hence the need for the political power to address it (Weingart, Engels & Pansegrau, 2000).

There is need for publics[2] globally to understand the scientific "facts" about climate change. Theorists who support this view argue that the majority of members of the public across the globe fail to engage and cope with climate change because they lack basic knowledge of its causes, processes, impacts and how to mitigate climate change (Lorenzoni, Nicholson-Cole & Whitmarsh, 2007). In other words, people's comprehension of the science of climate change is conceived as being a necessary condition to adapting and responding to the issue. This argumentation is entrenched in what is known as "the deficit model" of public understanding of science (PUS).

However, other theorists argue that besides public education about climate change, it is equally important for scientists, science communicators and science policymakers to understand the factors that influence public perceptions, beliefs and attitudes towards climate change. Previous research on the public understanding of climate change conducted in the

[2] Arguably, science does not have 'one generalised public' but 'many publics'. Thus, we should be talking about 'the publics of science' as opposed to 'the public of science'. This suggests that the equivalent meaning of 'publics' could be 'members of the public'.

United States of America (USA) and Europe suggest that people's beliefs, perceptions and attitudes do influence their support for voluntary and public initiatives to address climate change (Bord, Fisher & O'Connor, 1998; O'Connor, Bord & Fisher, 1999; Bord, O'Connor & Fisher, 2000; Whitmarsh, 2005; Zahran, Brody, Grover & Vedlitz, 2006; Eurobarometer, 2009, 2011; Bostrom et al., 2012). In other words, an investigation of the factors that influence people's perceptions, beliefs and attitudes towards climate change leads to a better understanding and appreciation of the contextual issues regarding the public understanding of climate change. This line of argumentation has been advocated by those who support what has become to be known as "the critical or contextual model" of PUS. The critical model thus shifts the emphasis from the education of a scientifically illiterate public to understanding of the social context and lay knowledge that play a significant part in how scientific knowledge is assimilated and used by members of the public (Michael, 2002).

Climate change is one phenomenon that has attracted the attention of researchers from across many disciplines. Climate change is not only a scientific issue but also a social, political, economic, and environmental problem. Presently, there are still protracted debates and controversies around the climate change issue. Some of these controversies have come about because there is little or no substantial evidence for some aspects of climate change. One way of resolving these controversies is to ensure that researchers conduct research that produces credible findings which are accepted by the wider scientific community and all the other stakeholders. Research on the public understanding of climate change could be seen as an attempt to bridge the gap between climate scientists and the public. Thus research on the public understanding of climate change is two-pronged: to improve the public's understanding of climate change, and also to help the experts understand the public and how they renegotiate climate change information. While some studies show that there is a general awareness and concern that climate change is one of the greatest challenges facing the world today, this has not translated into changed behaviour and lifestyles to mitigate climate change (Brechin & Bhandari, 2011; Lorenzoni & Langford, 2001). The different kinds of perceptions with regards to the seriousness of climate change to humanity and the ecosystem range from moderate to very serious. However, paradoxically, even those that consider climate change a very serious problem have not translated this concern into action. A substantial body of research on the public understanding of climate change suggests that understanding climate change is not only a knowledge issue but also one that requires a deeper understanding of the factors at play in the equation (Bostrom, Morgan, Fischhoff & Read, 1994; Sterman & Sweeney, 2007; Reynolds, Bostrom, Read & Morgan, 2010; Weber & Stern, 2011). Some studies suggest that perceptions, beliefs and attitudes to climate change, and support for climate change policies are influenced by a plethora of factors. An investigation into these factors is a worthwhile project.

1.2 Problem statement and focus

Most studies on the public understanding of global climate change have focussed on assessing the public's cognitive abilities to grasp the basic scientific facts about global climate change (Bostrom et al., 1994; Bord et al., 2000; Eurobarometer, 2009, 2011). Recently, there has been a shift to obtaining an understanding of the factors that influence lay beliefs about climate change (Leiserowitz, 2003; McCright, 2010; Egan & Mullin, 2012). Most of the research on this has been conducted in UK and USA. Unfortunately for Africa, research on this subject is yet to be done. Ironically, the majority of Africa's inhabitants are more vulnerable to climate change and variability because their livelihoods are principally dependent on subsistence rain-fed agriculture (Vincent, Cull, Chanika, Hamazakaza, Joubert, Macome & Mutonhodza-Davies, 2013; Tadross, Suarez, Lotsch, Hachigonta, Mdoka, Unganai, Lucio, Kamdonyo & Muchinda, 2009). Pidgeon (2010) points out the need for more contextual research on how levels of education, level of development, social, economic and environmental factors influence people's knowledge and support for climate change in many countries. Understandably, there is a great temptation among policymakers and science communicators in developing countries of Africa to generalise and use the findings in the UK and USA to develop and implement public policies in their respective countries without taking the local context into account. Policymakers and science communicators need to realise that the public understanding of climate change studies are done within a context. Additionally, understanding factors that influence the public understanding of climate change should help us appreciate how climate change information is assimilated and negotiated by lay people. Reynolds and colleagues (2010) emphasise the need for researchers, politicians and the media to listen to lay perspectives and to respond in a way that their communications support effective decision making.

1.3 Rationale

Some studies have established a link between people's perceptions about climate change and their acceptance or rejection of public policy proposals on climate change (O'Connor, Bord & Fisher, 1999; Leiserowitz, 2005). And there are many factors that could influence people's perceptions about climate change, and thus, indirectly people's acceptance or rejection of climate change policies. Many national governments are developing policies to deal with global climate change—a major threat to sustainable development and achievement of the Millennium Development Goals (MDGs). It is therefore important that policymakers, researchers and risk communicators understand the factors that influence people's perceptions, beliefs, and attitudes towards global climate change, especially in Sub-Saharan Africa—a region which is most vulnerable to climate change impacts, and which includes. Malawi. This study is probably the first more systematic research that uncovers the factors that influence people's perceptions, beliefs, and attitudes towards global climate change in Malawi.

1.4 Goals, theoretical points of departure, research questions and/or hypothesis

This study is founded on the broad theme of 'public understanding of science'. More specifically, I will discuss the two models that have informed the discussion on PUS, namely; the deficit model and the critical/contextual model. A discussion of empirical research conducted on the public understanding of climate change will attempt to unveil the main approaches researchers have used, discuss the findings and point out the limitations.

1.4.1 Main research question

The research attempts to answer the following main research question: What factors influence the public's perceptions, attitudes and beliefs about global climate change in Malawi?

1.4.2 Sub-questions

In order to answer the main research question, the study was guided by the following four sub-questions:

(i) What does the public in Malawi know and understand about climate change?

(ii) What perceptions, beliefs and attitudes do people have about climate change?

(iii) Does the impact of climate change on the livelihood of rural Malawians influence their perceptions, beliefs and attitudes towards climate change?

(iv) What factors predict perceptions, beliefs and attitudes towards climate change in Malawi?

(v) Does the impact of climate change on an individual's livelihood predict whther he/she will take voluntary action to address climate change?

1.4.3 Hypothesis

Considering that at least 85% of the population in Malawi live in rural areas and depend on subsistence rain-fed agriculture for their livelihood, and are therefore more vulnerable to climate change effects, I hypothesise that the perceptions, beliefs and attitudes of Malawians towards climate change will be influenced by some demographic and social contextual factors including the impact of climate change on livelihoods. Precisely, significantly more rural dwellers are likely to agree that their livelihood has been negatively affected by climate change compared with urban residents. In addition, significantly more rural inhabitants (who are more vulnerable to climate change effects) are likely to take voluntary action to address climate change compared with urban residents.

The figure below presents a conceptual framework of the factors influencing the perceptions, beliefs and attitudes towards climate change in Malawi that underpin my empirical work.

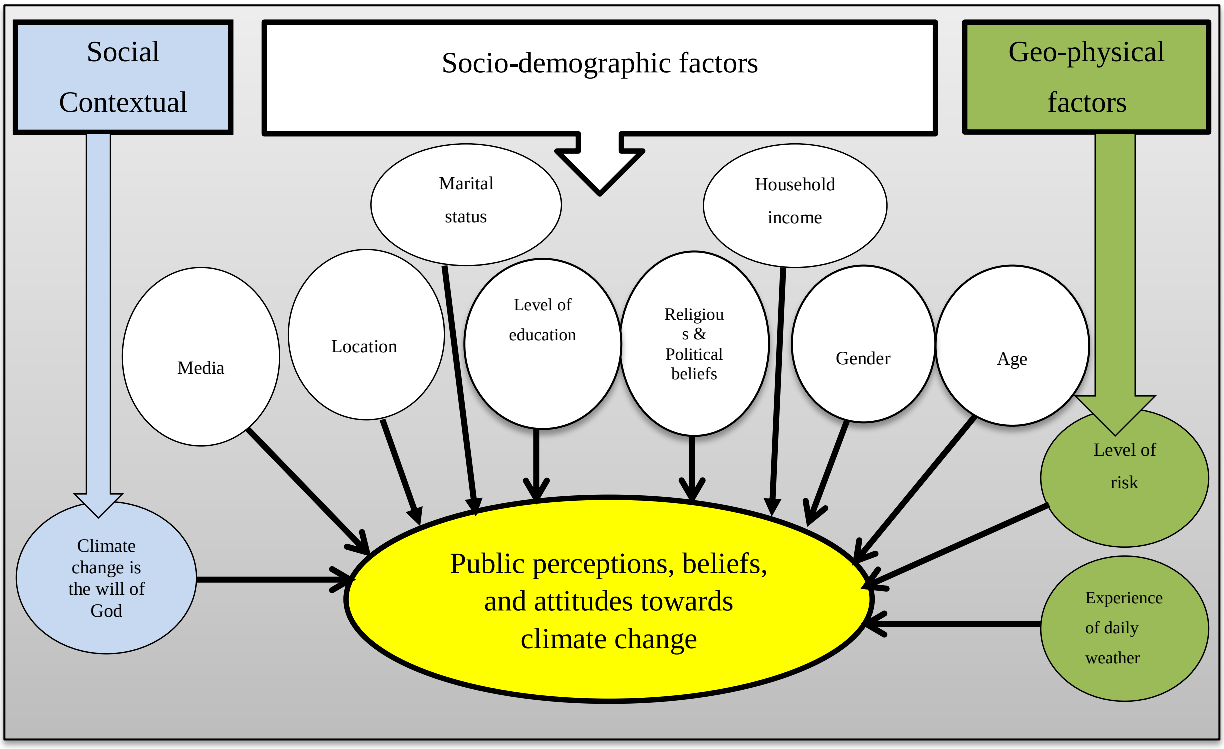

Figure 1.1: A conceptual framework of factors influencing perceptions, beliefs and attitudes towards climate change in Malawi

Figure 1.1 above postulates people's perceptions, beliefs and attitudes towards climate change as the key dependent variables of the study. Three clusters of factors i.e. social structural influences, socio-demographic influences and geophysical influences are postulated as independent variables. The arrows indicate the expected influence each of the independent variables has on people's beliefs about climate change.

1.5 Definitions

In this section I provide definitions of key words as they are used in this thesis.

- *Public:* The term should be understood to mean people from all walks of life including scholars, lawyers, teachers, farmers, business people, fishermen, students, media practitioners, members of the clergy, the media, etc.
- *Understanding*: How the public interact and negotiate with scientific information.
- *Climate change*: Changes in the geophysical and ecosystem as a result of emission of greenhouse gases, principally carbon dioxide, but also methane, chlorofluorocarbons (CFCs) and nitrous oxide into the atmosphere causing greenhouse effect.
- *Perception*: A process by which people translate sensory impressions of the world around them into a coherent and unified view.
- *Belief*: An assumption or conviction that is firmly held to be true.
- *Attitude*: A predisposition to respond positively or negatively towards a thing. Or, opinion or feeling that a person has about something.
- *Malawi*: A landlocked country located in South-east Africa with an estimated population of 15 million. Malawi's national economy is agro-based and 85% of its population live in rural areas and depend on rain-fed agriculture for their livelihood.

1.6 Brief chapter overview of the dissertation

This thesis is divided into seven chapters. Chapter 2 is the first part of literature review. It provides a review of literature on the two main research approaches to PUS research, namely: the deficit model and the critical model. An attempt has also been made to articulate the strengths and weaknesses of each of the two approaches. Reading this review, it is evident that in order to have a proper understanding of PUS research we need to devote attention to defining the terms embedded in the notion of 'public understanding of science,' namely: "public," "understanding," and "science". The chapter concludes by reiterating the need to reconceptualise PUS. Such a re-conceptualisation ought to be two-pronged: on the one hand, the public should endeavour to understand science; and on the other hand, scientists, scientific institutions, and science communicators and policymakers need to understand the public and the social context in which scientific knowledge is negotiated.

Chapter 3 is the second part of the literature review focussing on empirical studies that have been conducted on the public understanding of climate change. Most of these studies have been conducted in the USA and UK. It is clear from this review that a substantial amount of research investigating the public understanding of climate change has employed quantitative survey methodology. The findings indicate that despite the serious campaigns to educate the public about climate change, there has not been much uptake of scientific information about the issue. Some of the studies suggest that there are factors that influence perceptions, beliefs and attitudes towards climate change (Reynolds et al 2010). These studies call upon researchers to investigate factors that influence the public understanding of climate change. While some Western scholars have taken heed of the call by investigating factors that influence public perceptions, beliefs and attitudes towards climate change, research on this aspect in Africa is yet to develop. Thus, Chapter 3 identifies the research gap that exists on the public understanding of climate change in Africa, with a focus on investigating factors that influence perceptions, beliefs and attitudes towards climate change.

Chapter 4 provides an overview of the conceptualisation of the study i.e., the research questions, the hypothesis, and the independent- and dependent variables. Also, the chapter describes the design, methodology and methods that were used to analyse the data for the purposes of answering the research questions. It is emphasised in this chapter that the study is modest in scope, magnitude and approach. While employing a mixed-methods approach and with a sample size of 290 (i.e., Malawian adults who also head a household), the study attempts to investigate factors that influence public perceptions, beliefs and attitudes about climate change in Malawi.

Chapter 5 presents and discusses key findings for the study. Specifically, the chapter answers the following three research questions:

(i) What does the public in Malawi know and understand about climate change?
(ii) What perceptions, beliefs and attitudes do people have about global climate change?
(iii) Does the impact of climate change on the livelihood of rural Malawians influence their perceptions, beliefs and attitudes towards climate change?

Chapter 5 emphasises that the interpretation of the findings from the study requires the use of both contextual and positivist lenses. The results of the analyses affirm the hypothesis that the impact of climate change on people's livelihood is one of the factors that influences their perceptions, beliefs and attitudes towards climate change.

On the basis of findings discussed in Chapter 5, logistic regression analyses were performed to develop models that would predict the perceptions, beliefs and attitudes of Malawians towards climate change. Thus, Chapter Six presents and discusses the models that predicted Malawians' perceptions, beliefs and attitudes towards climate change. Specifically, the chapter addresses the following two questions: (i) What factors predict perceptions, beliefs and attitudes towards climate change in Malawi? (ii) Does the impact of climate change on an individual's livelihood significantly predict whether they will take voluntary action to address climate change? The results of logistic analyses show that there are five factors that predicted Malawians' perceptions, beliefs and attitudes towards climate change. Affirming the hypotheses, the results indicate that place of residence (or location) is the only predictor of the perception of the impact of climate change on an individual's livelihood. Specifically, rural inhabitants are significantly 6.5 times more likely than urban residents to agree that their livelihood has been negatively affected by climate change. Furthermore, rural dwellers are significantly 2.3 times more likely than urban residents to take action to address climate change.

Chapter 7 concludes the dissertation by recapping the main findings of the study. The chapter summarises findings on three aspects: (i) Malawians' understanding of climate change, (ii) factors influencing perceptions, beliefs and attitudes of Malawians towards climate, and (iii) factors predicting perceptions, beliefs and attitudes of Malawians towards climate change. The chapter also draws attention to the contribution the study makes to research on the public understanding of climate change. Additionally, some recommendations to science communicators and policymakers are made. The chapter concludes by suggesting areas that require further research.

1.7 Potential value of the study

This study is important because it is one of the first systematic and structured studies investigating the factors that influence perceptions, attitudes and beliefs about global climate change in Malawi. This means that this study fills an important gap in the public understanding of global climate change research. It is probably the first study in Sub-Saharan Africa to employ both qualitative and quantitative research approaches to investigate factors influencing perceptions, beliefs and attitudes towards climate change.

1.8 Connection with the doctoral programme at the Centre for Research on Evaluation, Science and Technology (CREST)

CREST has a well-established PhD programme in Science and Technology Studies (STS). This thesis connects to the theme of 'Science and its publics' within STS.

CHAPTER 2

PUBLIC UNDERSTANDING OF SCIENCE: CONCEPTUAL AND METHODOLOGICAL ISSUES: LITERATURE REVIEW

2.1 Introduction

For the past four decades there has been an increasing concern for widening gap between science and the public—what has come to be known as "Public understanding of science" (PUS). In its early stages of development, the phrase "public understanding of science" was associated with "scientific literacy". However, today public understanding of science (PUS) may mean both an attempt by the public to understand science, as well as improving the scientists' understanding of the public (Wynne, 1996; Turney, 1996). PUS is an area of inquiry that has attracted interest not only among natural scientists but also researchers belonging to fields such as sociology, social anthropology, psychology, history, political science, communication studies, and science policy analysis (Wynne, 1995; Bauer, Allum & Miller, 2007). This chapter reviews the background to PUS research, scientific literacy surveys carried out in the USA and the UK after World War II, and the relationship between science and society (or public) and the implication this has on PUS. The chapter also reviews the two historically dominant research perspectives on PUS, namely; the traditional and the critical models. An attempt is also made to articulate Mike Michael's (2002) 'heterogeneous PUS' which can be viewed as a modified critical model, but which can co-exist with the two 'old' approaches—the deficit and critical models. It is clear that each of these paradigms attempts to bridge the gap between science and the public, albeit to a limit. This is simply because the phrase "public understanding of science" inherently connotes a hierarchical distinction between science and the public.

Those calling for the public understanding of science are quite convinced that there is a need to improve the relationship between science and the public, yet they have not conceptualised what they really mean by 'public understanding of science'. Often the discourse on PUS takes for granted the meanings of the terms: *public*, *understanding*, and *science*. Indeed, the process of rethinking PUS should begin with conceptualisation of these three notions (Turney, 1996; Gregory & Miller, 1998). The chapter concludes by reiterating that one's conceptualisation of the relationship between science and society (or the public) is largely dependent on whether one problematises science or the public, or both. Suffice to say, a proper approach to PUS has to problematise both science and the public. This implies that, on the one hand, the public should acknowledge their lack of understanding of science and admit that beside their local knowledge, they also need to understand science, and on the other hand, science experts should admit that they have a sociological deficit i.e., lacking understanding that there are social, emotional and cultural aspects of science, and be willing to learn on how the public construct and negotiate scientific knowledge.

2.2 The concepts of 'public', 'understanding', and 'science'

People have been raising concerns about the relationship between science and society (or public). The sentiment is that there is an urgent need to improve understanding of the relationship between science and the public. This discussion has come to be known as 'public understanding of science'. The advocates use the low levels of public scientific literacy derived from quantitative surveys as strong empirical evidence that the public lack scientific knowledge, and therefore they need science education. However, other scholars have argued that PUS is not simply measuring public scientific literacy. They insist that 'public understanding of science' also means that scientists should understand how the public renegotiate and reconstruct scientific knowledge that is presented to them. Thus, PUS also calls on scientists to improve their understanding of the public (Turney, 1996: 1087).

Evidently, much discussion on PUS has focussed on what scientists and the lay public could do to achieve better public understanding of science (Gregory & Miller, 1998). But little attention has been devoted to understanding the meaning of 'public understanding of science', let alone conceptualising the terms 'public', 'understanding', and 'science'. It should be underscored that how one defines each of these terms has a bearing on the approach one will adopt in pursuing PUS vis-à-vis the critical model and the deficit model.

2.2.1 Understanding science and boundary-work

The term 'science' (from Latin word *scientia*, meaning 'knowledge') can be defined either narrowly or broadly. The narrower meaning of science entails the systematic investigation of phenomena of the natural world and the practical application of knowledge acquired from such investigation. This includes the study of biology, chemistry, physics, astronomy, and geology, and medicine, among others. The broader sense refers to a systematic way of pursuing knowledge. In this sense then, natural science disciplines as well as social sciences and humanities disciplines such as philosophy, psychology, sociology, and music, are also labelled as 'science'. In other words, whoever endeavours to systematically understand and explain the operations of either natural or social phenomena is a 'scientist'. It is unsurprising therefore to note that even in the world of academic scholarship some natural scientists consider themselves as "hard scientists" while despising the work done by their counterparts in the social sciences and humanities disciplines, and labelling them as "soft scientists". The term "hard science" is used by advocates to mean academic fields that are perceived as being more scientific, rigorous, and accurate and, concerned with discoveries far removed from human experience, while 'soft science' is a term that denotes those fields of academic research that are presumed to be understandable, devoid of mathematical rigor, and concerned with social phenomena (Lemons, 2008; Frost, no date). Obviously, some radical natural scientists may even consider social science and humanities research as unscientific.

For many years, scholars particularly historians, philosophers and sociologists of science have made important contributions to examine the nature of science. While some of these theorists argue that science has unique qualities that distinguish it from other practices, critics argue that scientific knowledge is socially constructed. This discussion has resulted in what is now called "the boundary problem", meaning the problem of demarcating science from non-science. Some scholars have made attempts to analyse "boundary-work". The notion of "boundary-work" was coined by Thomas F. Gieryn (1983, 1995, 1999) to mean the process whereby scientists and members of the public attempt to establish and negotiate the boundaries between science and non-scientific practices. On the one hand, scientists and analysts identify essential qualities and characteristics of the institution of science, subsequently assigning science a measure of "cognitive authority" in modern Western societies (Gieryn, 1995). On the other hand, people in society challenge this privileged status accorded to science by pointing out that cultural practices, other knowledge claims, and the local context are disregarded when analysts draw up the boundaries of science. In other words, people contest the meaning of science; and thus call for a redefinition of science. Gieryn (1995) identifies two main perspectives on the boundary problem, namely: essentialism and constructivism.

An essentialist perspective, also known as the common view of science, holds that science has unique, necessary, and invariant qualities that distinguish it from other practices. Science is perceived as a discipline that has its own distinctive elements, including a unique method (scientific method) which allows scientists to do research systematically so that truth is eventually discovered (Sismondo, 2004). This kind of framework—developed out of discourses within science studies, particularly in the work of Robert Merton in the 1940s—considers science to be superior to all other fields of enquiry, and has been embraced not only by ordinary people but also by scientists themselves. Historically, the development of essentialist perspective of science can be traced to as far back as 1920s when logical positivism emerged. Logical Positivism was a philosophical movement which arose in Austria in the 1920s and its main focus was on the logical analysis of scientific knowledge. Logical positivism views scientific theories as being created through a process of inductive accumulation. Accordingly, statements about metaphysics, religion and ethics are rejected as unscientific because they are void of cognitive meaning. In other words, it is impossible to verify the meaning of these propositions because they are beyond the realm of direct experience. Essentialists are preoccupied with boundary-work (Gieryn, 1995: 394).

The constructivist view, on the other hand, argues that there are no universal qualities that separate science from other knowledge-producing activities, and that this separation "is instead contextually contingent and an interests-driven pragmatic accomplishment drawing selectively on inconsistent and ambiguous attributes" (Gieryn, 1995: 393; also see Sismondo 2004). The constructivist perspective has been advanced by some sociologists of science who dismiss the attempts by essentialists to demarcate science from non-science. Constructivists watch members of the public i.e. scientists, potential scientists, journalists, technocrats, lawyers, researchers, science critics and other interested parties do boundary-work (Gieryn, 1995).

The boundary problem has attracted the attention of many theorists in science studies. Three theorists who have left an indelible mark in science studies are the philosopher of science, Karl R. Popper; the sociologist of science, Robert K. Merton; and the historian of science, Thomas S. Kuhn (Gieryn, 1995). Arguably, all these can be described as essentialists as each of them offers an articulation of the nature of science, thereby providing criteria for demarcating science from non-science. Let us take a critical look at the ideas espoused by each of these three.

Karl Popper (1902-1994) can be considered a strong critic of logical positivism. He attempted to provide an alternative model of science by rejecting the positivist view that scientific knowledge should be empirically verifiable. He was bemused by logical positivism for propagating authoritarianism in science. Logical positivism advocates an inductive logic, and developed the verifiability criterion for differentiating science from non-science. It argues that all scientific propositions must be conclusively verifiable. Popper argues that scientific knowledge does not progress through the continuous accumulation of more inductively established scientific facts and theories, but rather through a succession of bold conjectures which we attempt to refute. Popper argued that by using the principle of verification it is easy for one to find confirmations for almost all theories (Popper, 1963). He categorically rejected verification and attempted to resolve its associated problem of induction.

For Popper, demarcating science from non-science requires us to grasp the methodology of science, and this then accounts for science's superiority over other disciplines in providing valid and reliable knowledge about the world. In his analysis of the scientific method, Popper proposed that science uses falsification instead of verification. He argued that science advances towards truth through successive bold conjectures and refutations. According to Popper, science is more of a process of "trial and error" than a gradual accumulation of "truths". One can sum up all this by saying that the criterion of the scientific status of a theory is its falsifiability, or refutability, or testability (Popper, 1963). In this way Popper demarcated science from non-science (or pseudo-science). Popper posits that a good scientific theory is one that predicts more, is more falsifiable and survives rigorous tests to be falsified. For Popper, any theory that has been falsified must be rejected and abandoned. He therefore rejected the Marxist theory of history, psycho-analysis, individual psychology, and metaphysics as instances of pseudo-science since these are insulated from falsification and virtually explain and incorporate any other fact. Popper, like logical positivists, ignored that the choice of competing theories may be influenced by sociological factors. Popper's falsificationism, like logical positivism, has been heavily criticised for advocating inductivism to reject a theory. Popper's major critics include the historian of science, Thomas Kuhn and sociologist of science, Harry Collins.

Thomas Kuhn (1922-1996) can be regarded as both a philosopher and historian of science. Kuhn's view of science as espoused in his most influential work *The Structure of Scientific Revolutions* (1970, first published in 1962) is markedly different from that of the positivists and Popper. Kuhn's work presents a vivid picture of the role of history in understanding the nature of science. This perspective has been referred to as "Kuhn's historicism". Gieryn (1995) has observed that as much as Kuhn criticised Popper's falsificationism and Merton's social norms of science, nonetheless, he too could be considered as an essentialist. Gieryn (1995) argues that Kuhn was an essentialist not only because he offered paradigmatic consensus as a demarcation principle but [also] because he dismissed as unimportant, merely "semantic," those questions that animate constructive studies of boundary-work" (Gieryn, 1995: 403).

Using the multivalent notion of "paradigm", Kuhn argued that science does not progress by the accumulation of truths but by problem solving. Contrary to Popper, Kuhn saw science's progress as non-cumulative. The activity of science (normal science) is guided by a paradigm, and paradigms are incommensurable (Kuhn, [1962] 1970: 121). This means that scientists who work in two different paradigms see the world differently because the meanings of the theoretical terms are also different (Sismondo, 2004). Certainly, Kuhn's concept of paradigm does not only help in framing the agenda for specific research groups but also insulates them from possibly competing agendas coming from other practices (Gieryn, 1995). Kuhn argued that paradigms "provide scientists not only with a map but also with some of the directions essential for map-making" (Kuhn, [1962] 1970: 109). Social scientists are not insulated from competing knowledge claims because they are not guided by paradigms. Examples of paradigms in the history of science include Ptolemy's theory of planetary motion, Newtonian mechanics, Mendel's genetics, Lavoisier's chemistry. Kuhn identified stages or stages in the development of what he called "normal science". Normal science can be described as that which most scientists mostly do. Kuhn pointed out that research in normal science does not aim at novelty but puzzle solving. The periods of normal science are punctuated by revolutions that come about due to unresolved anomalies. Kuhn noted that there can be no "paradigm shift" without a crisis. A crisis stage is reached when an existing paradigm cannot solve problems. A revolution in science takes place when a new paradigm comes on the scene to solve serious problems which cannot be solved by an old paradigm. It is at this stage that some scientists, particularly younger scientists, embrace and adopt the new paradigm (Sismondo, 2004). Again, this counters Popper's view that scientists are continually searching for bold conjectures which are later subjected to rigorous tests. Kuhn observed that the history of science does not provide evidence for instant rejection of scientific theories. Thus the presence of an anomaly is not sufficient reason for paradigm change. Kuhn vehemently argued, "To reject one paradigm without simultaneously substituting another is to reject science itself" (Kuhn, 1970: 79). The new normal science and the old normal science belong to two completely different paradigms, such that these paradigms are incommensurable. Additionally, the rejection of one paradigm in preference for another is to a large extent determined by sociological and psychological factors and not by appeal to logic or empirical evidence. It is ironical that Kuhn who criticised Popper agreed with him that some knowledge and practices that do not have paradigms, such as astrology, are non-scientific because "they have no puzzles to solve and therefore no science to practice" (Kuhn, 1977: 276).

Robert K. Merton (1910-2003) a renowned American scholar can be described as a founding father of the sociology of science. Merton's major contribution to the sociology of science was his approach which identified science as a social institution with a characteristic ethos rather than as a type of knowledge (Merton, [1942] 1973; Hess, 1997). Merton's ideas have had such an influence on scholarship that the adjective "Mertonian" is used to refer to the "institutional sociology of science" (Hess, 1997). It is believed that Merton's views about the norms and values of science were influenced by functionalism—a social science theory that attempted "to explain the problem of order and survival, i.e., what it takes for a society to keep from falling apart, to reproduce itself, and to satisfy the basic requirements of adaptation to the environment of the natural world and of other societies" (Hess, 1997: 54-55). Specifically, Merton elaborated on and reacted to ideas of theorists like John Desmond Bernal, Max Weber, Talcott Parsons, Johannes Stark and Franz Boas, among others. Merton, just like Popper and Kuhn, is considered an essentialist because he attempted to develop a set of shared norms and values that uniquely define science and scientific practice. He called these norms the "ethos of science"— norms and values "which are held to be binding on the man of science" (Merton, [1942] 1973: 269).

Merton's ideas about the ethos of science were originally articulated in his 1942 essay. These ideas were also contained in Merton's *The Sociology of Science* (1973) with the heading "The Normative Structure of Science"[3]. In "The Normative Structure of Science," Merton describes science as an activity that involves social collaboration. For Merton, the institution of science aims at extending certified knowledge. For this goal to be achieved, the social and cultural structure of science should be identified. There are two parts to this structure; the first part is

[3] "The Normative Structure of Science"—a chapter in Merton's *The Sociology of Science* (1973)— was originally published as "Science and Technology in a Democratic Order," in the *Journal of Legal and Political Sociology* 1 (1942); and later published as a chapter in Merton's *Social Theory and Social Structure* (1949) with the title "Science and Democratic Social Structure". In the preface Merton wrote: "After a long gestation, the sociology of science has finally emerged as a distinct specialty" (Merton, 1973: ix). Merton is regarded by many as the founding father of sociology of science.

methodological. Thus scientists are called upon to employ technical methods to get the relevant definition of knowledge, i.e. statements of regularities ought to be empirically confirmed and logically consistent; and secondly, scientists need to adhere to moral or social norms.

Merton identified four norms or the ethos of science shared by practising scientists. The first is universalism, according to which scientists evaluate truth-claims using “pre-established impersonal criteria”. Universalism also means that personal and social attributes including race, nationality, gender, religion, social class, do not influence the allocation of rewards and resources. Communalism, the second norm is that the substantive scientific findings are the common property of the entire scientific community. This norm implores scientists to desist from secrecy and to rather communicate their findings to the public. Disinterestedness, the third norm, places a responsibility on scientists to present their results aside from their personal beliefs or activism for a cause. Scientists are called upon to pursue knowledge without any unknown ulterior motives to the scientific community. The final norm, “organised scepticism” is interlinked with the other norms of science. This norm encourages scientists to subject their knowledge claims to rigorous scrutiny of fellow scientists before they are accepted. According to Merton, these norms—which have not been codified—take the form of prescriptions, proscriptions, preferences, and permissions, are communicated and inculcated in the minds of scientists as standards for the practice of science, and they are reinforced by sanctions and rewards to transgressors and adherents, respectively (Merton, 1973; also see Gieryn, 1995). Merton seems to suggest that the norms of science provide protective mechanisms against outside attacks when he said: “Incipient and actual attacks upon the integrity of science have led scientists to recognise their dependence on particular types of social structure” (Merton, 1973: 267). Indeed, Merton’s social norms of science can be viewed as demarcation criteria, as they are useful for distinguishing science from non-science. For example, using Merton’s criteria, Nazi science and Soviet science—which were purportedly “scientific practices,”—were denied the status of science because they did not embrace the four social norms of science (Gieryn, 1995). Merton’s social norms have come to be known by the acronym “CUDOS” (standing for: communism, universalism, disinterestedness, originality, and scepticism).

The demarcation criteria developed by Popper, Kuhn, and Merton have far-reaching implications for the institution of science in liberal democratic societies. One major implication is that in modern democratic societies science is viewed as an autonomous institution (Hess, 1997). Thus, science ought to be free from the interference of the state, the church, the legal-judicial system, private capital, and other institutions, including individuals. Ironically, the ideal-type democracy promotes public participation and deliberation in issues that affect the citizenry. Some people have joined the chorus of those calling for science to be democratised. Democratisation of science means that the citizenry become active participants in the production of scientific knowledge. By implication, the autonomy of science stands opposed to the ideal of deliberative democracy. Others argue that the task of demarcating science does not belong to analysts, vis-à-vis philosophers, historians, and sociologists of science, but to people in society. Those who argue along this line are known as social constructivists.

Constructivism argues that that science does not have unique qualities that distinguish it from other practices. Constructivists assert that any endeavour to demarcate science from non-science is futile. Their interest is in investigating how scientific knowledge is constructed and negotiated by the lay public. It is argued that lay people’s knowledge, experiences, values and beliefs play an important role in the uptake of science (Wynne, 1991). In other words, people’s judgement of whether to accept or reject scientific knowledge is to a large extent influenced by the social context. Constructivism holds that a proper understanding of science can only be realised by studying how the lay public in a given social context interact with science. The other version of constructivism has come from the sociology of scientific knowledge. Sociologists of scientific knowledge concentrate on the actual content of science including theories, methods, experiments, and design choices as the subject of analysis (Pinch & Bijker, 1984; Hess, 1997). They argue that a close examination of the process of knowledge production as it happens at the site of scientific action (i.e., the laboratory) reveals that scientific knowledge does not have unique qualities as other historian, sociologists and philosophers of science claim, but rather it is socially constructed just like any social practice. This implies that science is not superior to the other cultural/social practices that generate knowledge.

Constructivists denigrate any attempt aimed at devising criteria for demarcating science from non-science. The sociology of scientific knowledge (SSK) developed in the early 1970s and 1980s as a new approach to thinking about science (Pickering, 1992: 1). The SSK is viewed as a critique of philosophy of science and the institutional sociology of science. The focus in SKK is on the content of science, also described as “opening the black box” of science (Hess, 1997). In fact, the advocates of SKK “have accused other sociologists of science of leaving the black box content unopened and examining only the exogenous, institutional aspects of science and technology" (Hess, 1997: 80). Thus, SKK is distinguished from other approaches in the sociology of science in two major ways. Firstly, it holds that science is constitutively social. Secondly, SSK asserts that the only way to understand scientific activity, which constitutes the content of science, is to use an anthropological approach. For example, sociologist of scientific knowledge Knorr-Cetina (1981) observed that in order to understand the practice of science we need a closer look at the process of knowledge manufacture in a laboratory which reveals that features of a scientist's reasoning showing the scientist to be a practical reasoner. A practical reasoner is someone "who refuses to be split into social and technical personalities" (Knorr-Cetina, 1981: 23).

Latour and Woolgar (1986)—based on their anthropological study carried out from October 1975 through August 1977 in Professor Roger Guillemin's laboratory at the Salk Institute for Biological Studies, California—also argue that science has no method but rather that scientific facts are socially constructed. Latour and Woolgar (1986) criticise some sociologists and philosophers of science. Philosophers of science are criticised for being so preoccupied with the abstract elements of science i.e., the nature of scientific method, and how this method enables scientists to discover truths of the natural world. Sociologists of science are also faulted for their focus on the large-scale effects of science which led to increased knowledge of the external effects and reception of science; and for studying science using approaches that resulted in the notion that the scientific world was completely different from the social world (or human affairs). They argue that a closer look at the activity of science reveals that scientists are "practical reasoners" and that scientific knowledge, just like any other knowledge, is socially constructed (Latour & Woolgar, 1986; also see Knorr-Cetina, 1981). Latour and Woolgar (1986) argue that in order to understand how scientific knowledge is produced we should be at the site of knowledge production—the laboratory. They argue that a closer look at the daily activities of working scientists in a laboratory lead to the construction of scientific facts, which are socially constructed.

Latour's 1987 book *Science in Action* is also a critique of the image of science that has been presented to the public. Latour (1987) posited that to a larger extent the public image of science is promoted by the social practice of scientists i.e., adherence to Merton's four social norms of science. He advanced the argument that in order for us to grasp the nature of scientific practice we should closely examine how scientists construct truth. This position has been referred to as the "social constructivist" approach (Gregory & Miller, 1998: 63).

However, constructivists have not been able to collapse the borders between science and non-science. Gieryn (1995) noted that despite constructivists raising doubts about the ability of criteria to demarcate science from non-science, science has retained a measure of “cognitive authority” in our world today. The paradox is why is it that other cultural practices that offer various accounts of reality cannot compete with science? On what grounds is the authority of science warranted? Some analysts have pointed out that constructivists have failed to collapse the borders between science and other practices considered non-scientific because clearly scientific enterprise belongs only to those that have undergone training in science, just like any other professional such as a lawyer, sociologist, economist, medical doctor, or journalist. As a matter of fact, even sociological constructivists merely observe how scientists construct scientific knowledge but cannot competently contribute to that science, let alone ascertain the “truth” of the science it observes; “sociology of science is sociology, not the science it observes” (Fuchs & Marshall, 1998: 4).

2.2.2 Understanding the public

At the heart of debates and activities regarding PUS is the notion of “the public”. And it is important that we understand what constitutes this public since “different conceptions of “the public” lead to different strategies for PUS, just as different conceptions of “understanding” lead to different assessments of the efficacy of the strategies” (Gregory & Miller, 1998: 95). Some scholars have attempted to closely examine the public who are the target of scientists, the media, and other interested parties who disseminate scientific information. These analyses have revealed that the public, just like ‘the public understanding’, is another black box whose contents are not very well known (Gregory & Miller, 1998: 8). Reading the arguments as advanced by proponents of the deficit model, one gets the impression that ‘the public of science’ is a homogenous and not a heterogeneous population. Often times, the public is understood in very general terms. However, what is now clear is that science does not have ‘one generalised public’ but ‘many publics’. Thus, we should be talking about ‘the publics of science’ as opposed to ‘the public of science’.

The concept of “public” has been subject of sociological inquiry for some time. Some ideas on what constitutes the public and public sphere have come from the German sociologist and philosopher Jürgen Habermas. For Habermas (1964), the notion of “public” has a positive connotation, entailing an assemblage of private individuals or citizens who have power, wealth, and influence and actively participate in debates over a myriad of issues with the ultimate goal of promoting their own social conditions and interests. What is noteworthy about this conceptualisation of the public is the fact that these citizens have knowledge about many issues. It is this knowledge that enables them to discuss issues and reach a consensus through what Habermas calls the "public sphere". By "public sphere" Habermas means "a realm of our social life in which something approaching public opinion can be formed," and "access is guaranteed to all citizens" (Habermas, 1964). Habermas argues that modern democratic societies ought to have the form of public that exhibit these qualities.

Habermas' conceptualisation of the public sphere goes some way to put the debates over approaches to PUS in the right perspective. On the one hand, the deficit model presumes that citizens are ignorant about science, and therefore need science education. This means that the citizens are passive and should have unquestioning support for science which purportedly brings so many benefits to society. In this sense, the deficit model views the public as a homogeneous group and passive recipients of information, disregarding how the information they receive will interact with their pre-existing knowledge, beliefs, values and attitudes (Gregory & Miller, 1998). For instance, the Royal Society (1985) defines 'the public' to mean "the predominantly non-scientific public" (Royal Society, 1985: 7). The deficit model conceives a passive public that cannot even demand for what they consider to be relevant to their individual situations. On the other hand, the critical model argues that in order to promote PUS, scientists need to change their perception about the public and appreciate that the public constitutes specific groups of active and thoughtful citizens (Gregory & Miller, 1998). Put another way, scientists need to understand that the notion of 'public' entails heterogeneity.

Indeed, conceptualising the public requires some degree of reflectivity for a proper understanding of PUS. We need a bigger picture of what is meant by "the public". Certainly, "the public" includes scholars, lawyers, health care professionals, farmers, fishermen, students, media practitioners, members of the clergy, the scientific institutions, the media institutions, and other institutions. However, as noted by Gregory and Miller (1998), in PUS discourses the notion of "the public" is narrowed to signify the "lay public or lay people"—that is to say "those with no expertise whatsoever". But again it is not simple to clearly define who a layperson is. Lay people can become experts in one field and lack expertise in other fields. For example, some studies (Wynne's studies of Cumbrian sheep farmers after the Chernobyl disaster) have provided significant evidence that lay people do possess knowledge that science experts do not have. This form of expertise— which tends to be specific or concrete rather than general or abstract—has been referred to as “lay expertise” or what others call “indigenous knowledge system”.

Science experts claim that their expertise is universal or generalisable. However, some evidence shows that this is not always the case. To take the argument further, one can also argue that most physicists who have little knowledge about biology can be considered as lay people. This means that even among scientists, just as is the case with the wider society, the dividing line between “expert” and “lay person” is flexible and dynamic (Gregory & Miller, 1998). As a way solving this puzzle, Evans and Plows (2007), using the typology of expertise as conceptualised by Collins and Evans (2002), propose that instead of talking about ‘scientists’ and ‘the public or publics’, to signify those with relevant specialist experience or knowledge about science, and those without specialist scientific knowledge, respectively, we should adopt the terms ‘experts’ and ‘non-experts’. This is plausible especially if one realises that there are some lay citizens who have knowledge about science though they have not undergone specialist science training. The appeal being made to scientists is that they should work together with the public as citizens of a scientific culture. This view has been strongly supported by a contextual or critical approach to PUS.

2.2.3 The meaning of ‘Understanding’

It is claimed that the most vexing task in PUS discourse has been to define the term “understanding” as embedded in “public understanding of science” (Gregory & Miller, 1998). Interestingly, there has been a lot of discussion on PUS, but there is little consensus as to what is meant by “understanding”. Some researchers who would like to improve the scientific literacy of the public equate “understanding” with “knowledge”. However, others concerned with increasing the public’s appreciation of science for the sake of continued public financial support equate “understanding” with “appreciation”. It becomes clear then that these advocates for ‘public understanding of science’ hardly specify precisely what they mean by understanding. What do they mean by increasing scientific knowledge? Do they mean improving public attitudes towards science? Do they mean increasing the public’s level of knowledge of particular scientific facts and discoveries? Do they mean increasing the public’s grasp of the scientific method? Do they mean enhancing the public’s comprehension of the nature of scientific activity and enquiry? Do they mean the public’s ability to grasp the aims, the norms, the processes, and products of science, or a combination of some or all of these? Or do they mean increasing the public's ability to criticise scientific institutions?

Some researchers equate 'understanding science' with 'the ability to understand and use scientific information (or scientific literacy)'. But what is scientific literacy? Various scholars have attempted to conceptualise the meaning of 'scientific literacy' (Durant, 1994; Wynne, 1995; Miller, 1998). In his examination of the various approaches to scientific literacy, Durant (1994) identified three meanings of the concept: knowing a lot of science; knowing how science works; and knowing how science really works. But Durant does not think that either knowledge of scientific facts or knowledge of the method(s) of science makes one understand science. Durant suggests that understanding of science may mean understanding science as an institution i.e., its norms, values, and belief system, its forms of patronage and control, and its social implications. Thomas and Durant (1987) aptly articulate this by saying that:

> "To be scientifically literate is not to be expert in anything in particular, but rather to be able to deal effectively with matters scientific as they arise in the course of life; it is to be able to cope with science in a way that is both respectful of scientists' legitimate expertise and wary of their many fallibilities and weakness; it is to be able to recognise science for what it is, and thus to make discerning judgements about its personal and social relevance" (Thomas & Durant, 1987: 13)

This means that any scientifically literate person understands the institutional characteristics of science, the capabilities and limitations of science, and the application of scientific knowledge in one's everyday life. Consequently, understanding science as an institution helps the public to understand how science really works (Durant, 1994).

But, what constitutes a reasonable level of scientific literacy? Is scientific literacy really attainable? Does the inability to use scientific knowledge necessarily mean that the person is scientifically illiterate? In attempting to answer these questions, Morris Shamos, an American physicist and science educator, argues that scientific literacy is a myth, and therefore unattainable (Shamos, 1995). The argument running throughout his book titled T*he Myth of Scientific Literacy* (1995) is premised on his definition of "scientific literacy" to mean "knowing some 'textbook' science" (Shamos, 1995: 231). Having examined how the American government had tried so hard to educate the citizens since World War II in science, but with no significant increase in levels of public scientific literacy, Shamos concludes that achieving PUS is almost an impossible mission (Shamos, 1995; Gregory & Miller, 1998;

Miller, 1998). Other scholars including Irwin and Wynne (1996) and Wynne (1995) have argued that one's inability to comprehend and use scientific knowledge does not necessarily mean lack of understanding; on the contrary, it may mean more understanding of science (Wynne, 1995: 363). It may also mean the knowledge is not relevant to that individual in his social context. This kind of understanding is what Michael (2002) has termed "apprehension" (Michael, 2002: 367).

Some proponents, particularly research institutions and popular science journalists, use the notion 'public understanding of science' to mean the 'public appreciation of the benefits that science brings to society'. Lewenstein (1992) has argued that both in America and the United Kingdom after World War II, the notion of 'public understanding of science' became equated with 'public appreciation of the benefits science provides to society,' though the science popularisers could not provide evidence of these benefits (Lewenstein, 1992). The motivation for popularising science was that increased knowledge about science would translate to more love and support for science (Royal Society, 1985; Lewenstein, 1992). The Royal Society Report (1985) also stressed the importance of better understanding of science not only to the scientific community but also to the general public. It states:

> "A basic thesis of this report is that the better public understanding of science can be a major element in promoting national prosperity, in raising the quality of public and private decision-making and in enriching the life of the individual…Improving public understanding of science is an investment in the future, not a luxury to be indulged in if and when resources allow" (Royal Society, 1985: 9).

The Royal Society (1985) cites a number of specific areas where an 'improved understanding' would make the world a better place. Wider PUS is justified in terms of national prosperity, economic performance, public policy, personal decisions, everyday life, risk and uncertainty, and contemporary thought and culture.

It has been observed that efforts to educate the public in science over the last few decades have not yielded the much expected results, i.e. public appreciation and support for science. Research to understand this paradox has concluded that feeding a lot of scientific information into the public domain does not necessarily translate to public appreciation of science. There are factors that influence the public's uptake of scientific information, let alone the love for science. The constructivist approach to PUS attempts to understand how the public interact, and negotiate with scientific information.

2.3 Public understanding of science in the USA and UK after World War II

The assertions that "we are living in a scientific world," or that "science made the modern world" have become part of our lexicon today. According to Shapin (2008), the idea that "science made the world" was first articulated by Alfred North Whitehead in his book *Science and the Modern World* (1925). In his book, Whitehead recounts the birth of science in Europe in the sixteenth and seventeenth centuries, and how scientific modes of thinking have spread across the whole world (Whitehead, [1925] 1946). But, do we really live in a scientific world? What does it mean to live in a scientific world? Does it mean that the public worldwide have faith in science, and hence ascribe to a set of scientific beliefs i.e., theories and facts? Or, does science mean an activity that has a prescribed method which is followed by all who practice it? Probably, it means that science has become our most powerful form of knowledge today. Put another way, perhaps scientists are now being considered the providers of solutions to both natural and social problems. As a result, scientists are esteemed highly and credited by governments and other social institutions for achieving useful goals i.e., wealth, health and power (Shapin, 2008). This perspective of the institution of science and scientists gained currency in the latter part of the nineteenth century and the first half of twentieth century. Those that subscribe to this view would like the public to think in scientific terms, for "to think any other way is to think inadequately, illegitimately, nonsensically" (Shapin, 2008: 433). In order for the public to think scientifically, the advocates argue, there is need to promote PUS.

Irwin and Wynne (1996) point out that the discussion of the relationship between science and the general public which has become known as the 'public understanding of science'—either from the viewpoint of public groups or of scientists—is nothing new. This has been a theme of writers, social scientists and scientists since the Industrial Revolution. This means that the current discussion on how the scientific community and their expertise should relate to the public is just a matter of renewed attention and social concern (Irwin & Wynne, 1996).

Until the late 1940s, many scientists did not view the popularising of science as an important part of their work. For a long time scientists had been trained in and accustomed to the view that the place of knowledge production is the laboratory, and that they are only accountable to fellow science experts. They looked at science popularisation as something outside the realm of scientific enterprise; many thought that involvement in popularising science might damage their reputation and career (Gregory & Miller, 1998). The public, on the other hand, were expected to marvel at the wonders of science and appreciate the benefits that science brought to society, but not to voice their opinions on scientific matters.

The turning point in the history of science popularisation was probably in 1959 following Charles P. Snow's influential Rede lecture titled "The Two Cultures" (the lecture was subsequently published with the title *The Two Cultures and the Scientific Revolution*) held on May 7, 1959, in the Senate House, Cambridge, United Kingdom. In his lecture, Snow lamented the growing gap between scientists and non-scientists—whom he termed "literary intellectuals". Snow argued that lack of communication between these "two cultures" of modern society was a major hindrance to socioeconomic development, and emphasised the need for non-scientists to understand science and its operations (Snow, 1959). This lecture provoked heated debate among scholars. What followed was an attempt by those who subscribed to Snow's views to bridge the gap by way of educating the public about science.

It is clear that both in the UK and USA immediately after the Second World War, the popularisers of science saw the popularisation of science as an avenue to promote PUS. This was a reaction to public ambivalence towards science. These advocates used the term 'public understanding of science' to mean 'public appreciation of the benefits that science provides to society' (Lewenstein, 1992). Implicit in the popularisation of science is that the public are mere recipients of scientific information; the public cannot communicate back to the popularisers what they know about science and the relevance of this knowledge to their everyday lives. However, the effort to popularise science is not without critics. Some critics argue that the call for PUS is motivated by scientists themselves whose ambition is to get more funds from the already overburdened taxpayer (Gregory & Miller, 1998: 2). Still others find fault with the activities that purport to improve the public's understanding of science, and yet these activities miserably fail to address the real needs and concerns of the citizens and to help them understand the world (Gregory & Miller, 1998: 2).

In the sections that follow, I discuss the historical and social contexts within which science popularisation developed, especially in the UK and USA soon after World War II. Specifically, I discuss why and how the American and British governments and their scientific establishment promoted the 'public appreciation of science' between 1945 and 1960.

2.3.1 Public understanding of science in the USA after World War II

The period between 1945 and 1960 could be described as the peak of science popularisation in the USA. Now that the war was over, there were generally mixed feelings and attitudes about the war and the role scientists had played. Most Americans were beginning to get anxious about the future. Having noted this, scientists saw the urgent need to improve public attitudes towards science. According to science communication scholar Bruce Lewenstein (1992), the period between 1945 and 1960 saw four different groups take up the task of popularising science. These four groups included commercial magazine publishers, scientific societies, science journalists, and government agencies. Apparently, all these groups had the overall goal of improving 'public understanding of science' which became equated with 'public appreciation of the benefits that society receives from science' (Lewenstein, 1992: 45). Interestingly, 'public understanding of science' meant different things and implied different actions to each group according to its own interests and goals. Two other things need to be pointed out. First, the four groups' agreement on the definition of 'public understanding of science' led to a significant collaboration and networking among them. Second, collaboration and networking among the groups could be attributed to some leading figures in these organisations whose interest was to promote and publicise science. These people influenced their organisations and institutions to support and fund the work of popularising science. Among these were Gerard Piel, Herbert Nichols, Jane Stafford, and Warren Weaver. Gerard Piel was a popular science publisher. He founded the 'new' *Scientific American*[4] in May 1948; he co-edited *Life* magazine[5] with Dennis Flanagan; he was an active member of both the USA National Association of Science Writers (NASW) and the Council for the Advancement of Science Writing (CASW). He also co-operated frequently with the American Association for the Advancement of Science (AAAS)[6] in the mid-1950s, before becoming chairman of the AAAS in 1986.

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[4] Gerard Piel, Dennis Flanagan, and their partners bought the 103-year-old Scientific American and pasted the original logo on top of their dummy. They retained the name *Scientific American*. Flanagan became the first editor of the magazine. The first issue of the 'new' *Scientific American* appeared in May 1948. The magazine's focus was on reporting new developments in science, especially stories on cybernetics, the H-bomb, the economic relations of science, the National Science Foundation, and the history of science. See Lewenstein, 1992: 51.

[5] *Life* magazine was edited by Gerard Piel and Dennis Flanagan. These two saw the need 'to serve the need of the scientist, the engineer, the doctor, the educator, and the intelligent layman for information concerning the progress of science, engineering, and medicine in all their branches and in their application at the social and economic level to the lives of all men. See Lewenstein, 1992: 50.

[6] According to its website, http://www.aaas.org, the American Association for the Advancement of Science (AAAS) was established in September, 1848, in Pennsylvania, USA. It is an international non-profit organisation dedicated to advancing science around the world. It publishes the well-known and high-impact journal *Science*

Arguably, Warren Weaver was instrumental in all the activities of popularising science in the USA. It is almost impossible to talk about 'public understanding of science' in the USA without Weaver in the picture. From 1945 to 1960 Weaver's name was quite familiar and important among scientists, science writers and journalists, commercial publishers and government institutions. He was a Rockefeller Foundation Officer; an active member of AAAS; served on the National Science Foundation's (NSF) board of directors; and Chairman of the Sloan Foundation. Weaver, a scientist himself, had a propensity "to use public presentations of scientific information as a way of strengthening both the intellectual and social authority of science" (Lewenstein 1992: 52). He argued that citizens in modern democratic societies needed to have "an improved understanding of what science is, how it operates, and the circumstances that make it prosper" for the simple reason that science is able to deal with the most complex and important social and political problems (Lewenstein, 1992).

In September 1951 Warren Weaver, who at the time was a Rockefeller Foundation Officer, as well as a member of the Executive Committee (then it was known as the Board of Directors) of the AAAS, reminded the Association of its long-standing constitutional commitment to PUS. He emphasised the need for the Association to focus on "the broader external problem of the relation of science to society". The statement (also known as the Arden House Statement because the meeting was held at Arden House) now became a new policy statement for AAAS, and read in part:

> …the AAAS [should] now begin to take seriously one statement of purpose that has long existed in its constitution…:to increase public understanding and appreciation of the importance and promise of the methods of science in human progress….in our modern society it is absolutely essential that science—the results of science, the nature and importance of basic research, the methods of science, the spirit of science—be better understood by government officials, by businessmen, indeed by all the people" (Warren Weaver, 1951 quoted in *Science* 114 (2 November): 471-472).

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as well as many scientific newsletters, books and reports, and spearheads programs that enhance understanding for science worldwide. *Science* has the largest paid circulation of any peer-reviewed general science journal in the world, with an estimated total readership of one million. Available at: http://www.aaas.org. Accessed on 10 February, 2012.

The above statement is an example of how the scientific community in the USA was mobilized to popularise science. This statement called for an active reassessment and redirection of AAAS so as to respond to the public's 'demand' for science. However, there was no evidence that such demand existed in USA at the time. Weaver began to implement the Arden House Statement of Policy for the AAAS soon after he was elected President of AAAS. In the years that followed, AAAS initiated programmes for the mass media and for mass public education.

Weaver also funded NASW's activities, including three separate surveys that were conducted from 1955 to 1958. In 1958 while serving as board of directors at NSF, Weaver criticised the foundation for its lack of attention to 'public informational activities'. He then initiated the 'Public Understanding of Science' programme with a budget of $1.5 million. In 1960 Weaver (who had then moved to become Vice-President at the Sloan Foundation), provided a newly created grouping of professional science writers known as the Council for the Advancement of Science Writing (CASW) with $110 000 to support science writing seminars. CASW—created in 1960 to interpret science and its meaning to society—had applied for funding from Sloan Foundation to undertake a three-year project to 'change the climate of appreciation for scientists and the scientific enterprise'. It should also be noted that Weaver was also instrumental in the establishment of CASW.

In order for us to appreciate Warren Weaver's motivation for science popularisation, we need to articulate his personal perceptions and beliefs about science. In his speech at the end of his tenure as President of AAAS on December 28, 1955, Weaver said:

> It is hardly necessary to argue these days that science is essential to the public. It is becoming equally true, as the support of science moves more and more to state sources, that the public is essential to science. The lack of general comprehension of science is thus dangerous both to science and to the public, these being interlocked aspects of the common danger that scientists will not be given the freedom, the understanding, and the support that are necessary for vigorous and imaginative development" (quoted in Mina Rees' *Warren Weaver—Biographical Memoir* 1987: 509).

Weaver also believed that:

> "Science is not technology, it is not gadgetry, it is not some mysterious cult, it is not a great mechanical monster. Science is an adventure of the human spirit. It is an essentially artistic

enterprise…based largely on faith in the reasonableness, order, and beauty of the universe of which man is a part" (Weaver, 1960: 104-105).

From the above statements one can clearly see that as far as Weaver was concerned, science was indispensable, to such an extent that he desired that every American citizen should understand and appreciate the importance and promise of the value and operations of science for socioeconomic development. But at the same time one can also sense the anxiety and fears about low research funding for science that was imminent if the public were not to 'appreciate science'. It is therefore no surprise that Weaver used his influence and supported the popularisation of science in the USA. In order to decode how and why PUS in the USA became equated with the 'public appreciation of the benefits that science brings to society' one needs an understanding of Weaver's beliefs and vision of science. As a way of acknowledging Weaver's outstanding contributions to PUS to the contemporary world, he was awarded the first Arches of Science Medal in 1965. In the same year, he was also awarded the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Kalinga Prize for his distinguished contributions to the popular understanding of science.

The early 1960s marked the beginning of an era when criticism against popular science began to appear in the USA. The birth of environmental movements, coupled with the rise of critics of popular science such as Barry Commoner, Theodore Roszak and Jacques Ellul, began to erode the public appreciation of science that had reigned for the preceding 20 years (Pion & Lipsey, 1981; Lewenstein, 1992). This posed a big challenge to scientists who were also busy advocating for PUS. There was therefore a need for scientists to counter these criticisms. One major strategy the scientific establishment used to counter the criticisms was to conduct surveys on public attitudes on science (these have become known as scientific literacy surveys), and use this as a basis for promoting science education. But before we proceed to review some of the USA surveys on public attitudes towards science, we should discuss the context of PUS in the UK.

2.3.2 Public understanding of science in the UK after World War II

Unlike in the USA, it is very difficult to tell a story of public science in the UK between 1945 and 1985. This is because during this period the attitudes of the UK public towards science ranged from great adulation and expectation, to disappointment and even hostility, giving way to ambivalence (Miller, 2001: 115). Certainly, from 1985 onwards one is able to get a clearer picture of the movement of PUS and the efforts to promote science education. As in the case of the USA, in the UK after the Second World War the term 'public understanding of science' became equated with 'the public appreciation of the benefits that society gets from science'.

Writing immediately after the Second World War, the UK's Association of Scientific Workers in their programmatic *Science and the Nation* (1947) observed the need for the public to be educated on science so as to improve their understanding of science. Science education was perceived as the only way to improve the public's literacy in science. The argument for science education drew upon three of the most commonly stated justifications for an 'improved' PUS: Firstly, that a technically literate population is essential for future workforce requirements; secondly, that science is now an essential part of our cultural understanding; and thirdly, that improving PUS is essential for a modern democracy (Irwin & Wynne, 1996: 4). In the years following this publication, the Association of Scientific Workers embarked on science education, which was done through further education classes and such media as exhibitions and museums, film, the press, and radio (Irwin & Wynne, 1996). Even at this early stage of PUS discourse in UK, the scientists there were inclined to think that the public was illiterate in science. In other words, the scientists problematised the public. This is how scientists conceptualised the issue of PUS in the UK, and this has been passed on to the modern generation of scientists.

The debate over PUS re-emerged in the UK in 1985 with the publication of a Royal Society[7] report. This report is also popularly known as the Bodmer Report after the Chairperson of the working group, Sir Walter F. Bodmer (Irwin & Wynne, 1996; Miller, 2001). Bodmer, a geneticist himself, and his working group—most of whom were prominent scientists—were mandated by The Council of the Royal Society to "investigate ways in which PUS might be enhanced" (Royal Society, 1985: 7). The group had four terms of reference. These were: "to review the nature and extent of PUS in the UK and its adequacy for an advanced democracy; to review the mechanisms for effecting PUS and technology and its role in society; to consider the constraints upon the processes of communication and how they might be overcome; and to make recommendations and report to Council" (Royal Society, 1985: 7).

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[7]The Royal Society's 1985 report was titled *The Public Understanding of Science*. The Royal Society is Britain's premier scientific institution and has the three major roles of promoting the natural and applied sciences, a learned society, and a funding agency. Its mission is "to expand the frontiers of knowledge by championing the development and use of science, mathematics, engineering and medicine for the benefit of humanity and the good of the planet." More information about The Royal Society is available at: http//www.royalsociety.org.

Among the recommendations of the report, it advocated for more science education, and also encouraged scientists to acquire skills to enable them to communicate science with the public so as to improve the public's understanding of science. It argued that it is the responsibility of each scientist to promote the PUS. Bodmer and colleagues observed that, hitherto, there were many surveys that were carried out on the public's attitudes to science and technology both in UK and USA. Nonetheless, there was a need for more research to assess the public's understanding of science and technology, with special attention to the ways of measuring PUS, and the effectiveness of such approaches. Thus, the Royal Society saw the need for natural scientists to work together with social science researchers— particularly in terms of gauging the present level of the public understanding (or ignorance) of science, assessing the effects of improved understanding, and discovering sources from which individuals obtain scientific information. This programme was coordinated and financed by the Economic and Social Research Council (ESRC) (Gregory & Miller, 1998). It was also in the late 1980s that the UK Royal Society formed the Committee for the Public Understanding of Science (CoPUS), thus institutionalising the subject (Irwin & Wynne, 1996: 4). CoPUS was an organisation with representatives from the Royal Society, the British Association for the Advancement of Science, and the Royal Institution. The overall goal of CoPUS was to promote public understanding and appreciation of science. One can therefore argue that science popularisation in the UK was legitimised by the Bodmer Report (Miller, 2001).

It should be pointed out that the Royal Society's report was written based on views exclusively solicited from scientists, and that no members of the non-scientific public were consulted (Gregory & Miller, 1998: 6). One can therefore argue that the findings and recommendations contained in Bodmer's report were biased towards the practice of science since there was no input from the general public. The views of the general public should have been incorporated so as to grasp how they constructed the meaning of science in their social contexts.

2.4 Public attitudes towards science: What have the USA and UK surveys told us?

The period after World War II saw a numbers of surveys of public attitudes towards science and technology being conducted both in USA and the UK by government institutions as well as individual researchers. The USA and the UK are two of the few countries where more effort has been made to survey public attitudes to science. These surveys— which have come to be known as “scientific literacy” surveys— have been used as a basis for advancing science education with the ultimate goal of promoting PUS. The underlying assumption is that people’s attitudes to science is a function of their knowledge of science, which is measured by how well they are capable of cognitively defining and explaining scientific facts. In other words, the advocates equate one’s attitudes towards science with scientific literacy.

Most of the UK and USA surveys have found that the publics are scientifically illiterate. Governments and scientists have used these survey results to argue that the publics are indeed “scientifically illiterate”, and therefore need science education. There were reasons why scientists and governments promoted science education soon after the Second World War, but these fall outside the scope of this discussion. Suffice it to say that both in the UK and USA after Second World War the meaning of PUS became equated with the ‘public appreciation of the benefits that science provides to society’ (Lewenstein, 1992). Thus, the argument being advanced by advocates of PUS has been that the more the public know (or understand) science, the more they will come to love and support science. In the sections that follow, I review some of the surveys on public attitudes to science that have been conducted from 1950s to the early 1980s.

2.4.1 Scientific literacy surveys and PUS in USA after World War II

One of the earliest notable national surveys on public attitudes towards science and technology in the USA was conducted by Withey and Davis for the Survey Research Center at the University of Michigan from 1957 to 1958 (Davis, 1958; Withey 1959; Pion & Lipsey, 1981; Etzioni & Nunn, 1974). These surveys assessed people’s attitudes to science prior and after the Sputnik debacle. In their analysis of the 1957-1958 surveys, Pion and Lipsey (1981) observe that the findings revealed that there was generally a positive attitude towards science from the American public (83% of the respondents thought that “the world was better off” because of science[8] while only 2% said that science has made the world worse off) but that levels of factual knowledge of science were low (Gregory & Miller, 1998). Most Americans were positive about science because they thought it was instrumental in achieving their personal goals (Etzioni & Nunn, 1974: 192). While surveys conducted in 1950s show a high percentage of Americans favouring science, people’s attitudes to science drastically changed

[8] In these surveys a definition of “science” was provided to the respondents which included both scientific and technological activities.

in the 1960s and 1970s. For example, Louis Harris' polls carried out in 1966, 1971, and 1972, found that 56%, 32%, and 37% of Americans, respectively, had confidence in science (Etzioni & Nunn, 1974). Another survey carried out by NASW in 1957 to measure levels of scientific literacy found that only 12% of the American public could give a satisfactory answer when asked to describe, in their own words, what it meant to study something scientifically[9] (Wynne, 1995; Gregory & Miller, 1998). NASW interpreted this to mean that there was a need for more science writing and education to improve the public appreciation of science.

But this interpretation might have been wrong since advocating for more science writing and science education did not yield the expected outcomes. Wynne (1995), cites Bauer (1992) as arguing that by asking an open-ended question and demanding respondents to provide a "correct" answer, the "[survey] does not measure people's understanding of science but the diffusion of a certain notion of science among the public" (Martin W. Bauer quoted in Wynne 1995: 366). This same open question was retained by the NSF Science Indicators surveys which were conducted from 1972 onwards (Wynne, 1995). These research findings seem to suggest that more scientific information and education does not necessarily lead to greater PUS.

Systematic surveys about public attitudes to science among the American public began in 1972 (Gregory & Miller, 1998: 4). Since 1972 the NSF has carried out biennial "Science Indicators" surveys—social surveys conducted once every two years to gather data on levels of attentiveness to science[10], public understanding of, and attitudes to science (Gregory & Miller, 1998; Wynne, 1995). Since 1979, an American political scientist, Jon D. Miller, has developed and analysed the NSF surveys (Gregory & Miller, 1998; Bauer, Allum & Miller, 2007). Miller conceptualised a definition of "science literacy" and also constructed survey-based indicators of scientific literacy, and these became the basis of the NSF surveys (Withey, 1959; Bauer et al., 2007) Miller's definition of "science literacy" included four elements, namely: knowledge of basic textbook scientific facts; understanding the methods of science;

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[9] A satisfactory answer was one that included the notion of testing and modifying hypotheses by, and in the light of, experiment. See Gregory & Miller, 1998: 5.

[10] According to Miller (1991), "attentiveness" to science is defined by an index that combines self-reported interest in scientific issues, self-reported level of knowledge, and regular use of different sources of information. Thus, an "attentive public" in these surveys entailed those who were scientifically literate. In all these studies carried by Miller, the "attentive public" (scientifically literate) was less than 10% of the American population. Also see Wynne, 1995.

the rejection of superstitious beliefs; and an appreciation of the positive outcomes of science and technology for science (Miller, 1992; 1998).

The data presented in the "Science Indicators" revealed three important findings. Firstly, the data show that the Americans' support for basic scientific research was dwindling in the 1970s, whereas the support for applied science (or technology) grew. For instance, the 1979 survey found that only 9% of the American public saw fundamental research as a priority for science and technology. This was lower than that found in 1974 (21%) and 1972 (19%) (Royal Society, 1985: 14). An analysis of 1976 "Science Indicators" also shows that the respondents emphasised practical benefits as the desired outcome of scientific and technological pursuits (Pion & Lipsey, 1981). Some of these benefits included improving health care, reducing crime and drug addiction, and controlling pollution. Other earlier surveys such as a 1971 Harris poll (1971) found that at least 85% of the American public agreed that "technology does more good than harm", while Taviss (1972) reported that 76% of the respondents in her study agreed with the same statement (Pion & Lipsey, 1981). It became clear that the American public was inclined to identify more with technological development and its impacts than with science, for the simple reason that technology directly affected their daily human affairs.

Secondly, these biennial surveys showed that there was little improvement in adult scientific literacy over time (Gregory & Miller, 1998). Generally, the respondents in all the surveys could not competently answer basic questions about science. Thus the American public could be described as a generally scientifically illiterate society. For instance, the 1979 survey found that only 14 % of Americans could give a satisfactory answer when asked what it meant to study something scientifically. Of this 14%, at least half had failed other tests including believing that astrology was at least "sort of" scientific. This meant that in 1979 the overall percentage of Americans who were literate in science was 7%. This percentage decreased to 5% in 1985. The 1985 survey required that respondents show understanding of three aspects of science in order for them to be considered as scientifically literate. These aspects were: scientific process; basic terms and concepts; and the impact of science and technology (Gregory & Miller, 1998). Some theorists on PUS have observed that the 1985 percentage of scientific literate Americans was the lowest because the test criteria used were absolutely stringent. They argue that a number of methodological flaws are identifiable with this type of definition of scientific literacy, and doubt whether universal scientific literacy can be achieved at all.

The third finding of these surveys was that while over 90% of the American public was illiterate in science, over 70% of the Americans held science in high esteem; they generally believed that science would continue to be of benefit to society, and that the beneficial consequences of scientific research would outweigh the harmful consequences. In other words, the respondents' self-reported interest in science seemed to be greater than their self-reported knowledge of science (Gregory & Miller, 1998). This was interpreted to mean that there was a high public demand for science, hence the need for more scientific information in the public domain (Gregory & Miller, 1998). For instance, the "Science Indicators" of 1972, 1974 and 1976 found that 70%, 75%, and 71% of respondents, respectively, agreed that science and technology have changed the world for the better, and would continue to do so in the future. Two other observations have also been made about the responses to the survey questions: first, that those who were closest to science had a better understanding of science and appreciated the value that science has to society; and second, that respondents' assessment of whether or not science is a good thing depended on the precise phrasing of the question (Pion & Lipsey, 1981; Royal Society, 1985: 14).

From the late 1980s onwards, the USA "Science Indicators" have been compared with similar surveys carried out in Japan, India, Canada, China, Bulgaria, Switzerland, Britain, Singapore, France, Germany and other EU countries (Bauer et al., 2007). Notably, the major challenge of such comparisons remains determining the validity and reliability of the indicators (Bauer et al., 2007). Nonetheless, these efforts have helped in the establishment of an international framework for measuring PUS (Wynne, 1995).

Some USA studies on public perceptions of science have attempted to identify distinct sub-publics defined by social characteristics such as age, income levels, and education that are actually antagonistic to science (Etzioni & Nunn, 1974). Some studies carried out in USA in the 1970s found that the educated young are the most alienated from science and technology while other studies suggest that college graduates have favourable attitudes to scientists (Etzioni & Nunn, 1974). Studies conducted throughout 1960s and 1970s show that the educated young held favourable views of science (see Funkhouser & Maccoby, 1970; Pion & Lipsey, 1981). An analysis of surveys by University of Chicago's National Opinion Research Center's (NORC) by Etzioni and Nunn (1974) shows that American youth (respondents aged between 18 and 29) had more confidence than any other group in scientists. Some studies, for instance, Taviss (1972), found that there was no significant age difference between respondents with more confidence and those with no confidence in scientists. Pion and Lipsey (1981) argued that the debate on the influence of age and education on one's views of science is somewhat inconclusive. Additionally, these studies show that the socioeconomic factors have an impact on people's trust or confidence in scientists (Etzioni & Nunn, 1974; Pion & Lipsey, 1981), although some studies seem to suggest otherwise. This supports the observation that there is need for more research on factors that may influence on the public's understanding of science.

The main thrust of the PUS movement in the USA has been to increase "public scientific literacy," with attention focussed on school and college students (Gregory & Miller, 1998: 7). The motive for this was the assumption that increased literacy in science would lead to more appreciation of and support for science.

2.4.2 Scientific literacy surveys and PUS in the UK after World War II

Since 1977, a number of systematic surveys have been carried out to gauge public attitudes to science and technology across Europe. Between 1977 and 1983 the Commission of the European Communities (CEC) conducted four surveys in eight countries which formed the European Community at the time, as well as in Luxembourg. Each of these CEC surveys involved representative samples of about 1000 adults in each of the member countries of the European Community at the time, and about 300 adults in Luxembourg (Royal Society, 1985: 12). The first CEC survey results were published in 1977. This survey covered 'Science and European public opinion'. Among other things, the survey reported that there was a general feeling among those interviewed that scientists could still be trusted. The public thought science had been and would continue to play an important role in the improvement of daily life, although they pointed out that science could also be dangerous at times. The public indicated support for scientific research that related to immediate human welfare, but had a negative attitude towards scientific research dealing with issues far removed from people's daily experiences, such as space exploration and defence research. Of those interviewed, 66% indicated that they relied on the media for scientific information.

The 1979 CEC survey looked at attitudes that Europeans had to scientific and technical developments. Like the 1977 survey, respondents indicated that science would continue to be beneficial to society, and indicated their willingness to know more about science, understand the details of scientific and technical developments. The public expressed interest in being involved in the formulation of the national research policy. The UK respondents, unlike those of other countries, were less likely to oppose the construction of machinery in favour of going back to nature. The survey also found that there was a general concern about the impacts of technological developments on people's daily lives. For instance, of the total respondents, 80% was 'really concerned' about environmental pollution; 67% about automation and unemployment; 53% about the risk of medical or pharmaceutical discoveries accidentally damaging humans severely; and 53% about the increasing impact of 'artificial things of all sorts' on daily life (Royal Society, 1985: 13).

The 1982 CEC survey focussed more on energy, while the focus of the 1983 survey was the environment. One of the interesting findings of the 1982 survey was that the public could not understand information about energy and related issues presented to them by the mass media and tended to blame the mass media for their own lack of knowledge (Royal Society, 1985: 13). Most of the respondents were not aware of the risks of a breakdown in energy supply and developed a strong emotional attitude to energy issues. The public, however, pointed out the need for more research in renewable energy sources.

The 1983 survey reported that the European public placed a high priority on environmental issues. It also reported a generally greater concern about the national and global environments but the public indicated they were comfortable with local environments. An interesting observation in this survey was that the level of concern among the UK respondents was slightly lower than the European average on all issues except nuclear waste disposal (Royal Society, 1985: 13).

Another interesting survey in UK was conducted in 1975 by Hills and Shallis. This survey, which however was unrepresentative, had 1228 *New Scientist* readers and 331 *New Society* readers as respondents. The survey was about the readers' views of scientists. The respondents included both scientists and non-scientists. The survey found that there was consensus among the respondents that scientists were held in high regard by the public and were objective, but noted that this image was partly projected by the scientists themselves to the public. Scientist respondents, on the one hand, were of the view that scientists are typically approachable, sociable, open, unconventional, socially responsible, and popular with broad interests. The majority of non-scientist respondents, on the other, saw typical scientists as the opposite: remote, withdrawn, unpopular, singular-minded, and secretive (Pion & Lipsey, 1981; Royal Society, 1985).

In 1985 the *New Scientist* commissioned a survey about public attitudes towards science in the UK. This survey was a representative quota sample of adults, and was carried out by Gallup. The general findings of this survey were to a larger extent similar to those found in the 1977 CEC survey. However, with respect to institutions trusted by the public, this survey ranked science below medicine, the armed forces, and the law. Other findings of the survey were that 89% of respondents agreed that children needed to study at least some science until they reached age of 16; 84% agreed that ‘scientists and technologists should pay more attention to the social implications of their work’; and 76% agreed that ‘politicians should know more about science and its implications’. Additionally, 36% were not able to name a single major scientific achievement after the Second World War, while 47% could not mention any past or present prominent scientists.

In 1988, three years after the establishment of CoPUS, the first systematic survey was conducted in UK to assess level of scientific literacy among the British public (Miller, 2001). This survey was carried out by John Durant, Geoffrey Evans, and Geoffrey Thomas. This survey showed that the British public in response to the question “what does it mean to study something scientifically?”, only 11% gave an answer that involved the idea of experimentation, while a mere 3% mentioned testing hypothesis (Gregory & Miller, 1998: 5). These findings were more or less similar to those found in USA scientific literacy surveys. For instance, the 1985 USA survey found that only 5% of Americans were scientifically literate.

In the UK, just like in the USA, the main thrust of the PUS movement has been to increase ‘public scientific literacy’ with a focus on educating adults, families, and community groups (Gregory & Miller, 1998: 7).

Hitherto, research on PUS has focussed on measuring public knowledge about science. In the sections that follow, I attempt to give a background to the renewed interest in PUS— that is very conspicuous from the early 1990s. The focus since 1990 has been on articulating the nature of the relationship between science, on one hand, and society, on the other, but this has been overshadowed by the heated debates between the deficit model and critical model over the “proper” methodology for doing PUS research.

2.5 The "recent" movement of PUS: What does this mean? Why should the public understand science?

Public understanding of science (PUS) can be considered as a wide and, in general, ill-defined area involving several different disciplinary perspectives. There is no one acceptable definition of PUS. The definitions are heavily shaped by how one problematises the PUS issue. Some problematise the publics while others problematise science. The discourse on PUS took on the trappings of institutionalisation from the mid-1980s (Wynne, 1995). In other words, it is only from the mid-1980s onwards that systematic research on PUS started.

As pointed out earlier, the discourse on PUS has a long history. The peak, however, was reached around the mid-1980s when scientists and critics alike had to define the nature of the relationship between science and society. Generally during this period, following public concerns about industrial pollution, nuclear energy, and other related issues, the public attitudes to science were distinctly ambivalent (Gregory & Miller, 1998: 3). In addition to this, most national governments thought supporting scientific research was expensive and were looking to reduce budgets. The rebirth of PUS "movement" from the late 1980s has been ably articulated by Gregory and Miller (1998) who point out that the efforts by experts and advocates to promote science has attracted the reactions of social scientists, scholars, and other interest groups, and all this has become known as "public understanding of science". Experts and critics of PUS have engaged in debates on how science should be communicated with the public. The scientists, on the one hand, blame the public for not understanding the basic scientific facts. Critics, on the other hand, fault scientists for not understanding the public and ways in which they interact with science. So, what we see here is renewed interest in PUS, with particular focus on the relationship between the public and science. Indeed, the movement of PUS has arrived, and it is here to stay (Gregory & Miller, 1998).

But, what exactly do we mean by PUS; and why does PUS really matter? How should we do research on PUS? These and other related questions point to the need for closer examination on the relationship between science and the public.

2.6 The main research paradigms for PUS

Public understanding of science (PUS) is a very complex field of research involving several different disciplinary perspectives (Wynne, 1995: 361). Discourses on PUS can be traced to as far back as the 1950s when large-scale public attitudes to science surveys began. However, it is only since the mid-1980s that the PUS issue has been institutionalised across the globe. Systematic research on PUS also dates only from the 1980s (Wynne, 1995).

There are two main research approaches to PUS. These are: traditional (or positivist) and critical (or interpretationist or contextual) approaches. There are three approaches that fall under the traditional PUS, namely: surveys, the study of mental models, and theory of social representations (Michael, 2002). The predominant approach, however, is survey studies of the public understanding of science, which is why traditional PUS is associated with quantitative large-scale surveys. The other research approach is the critical/contextual approach which is primarily identified by its use of qualitative techniques. It has a keen interest in the cultural context of the PUS. From the arguments put forward by the advocates of each of these models, it is clear that these two are very different and even incompatible approaches, and the battle over superiority between these two—which has been there since the 1980s—rages on. The major irreconcilable differences between the two models emanate from their conceptualisations of the public, science, and understanding. Despite the differences, both the traditional and critical perspectives share some commonalities. These include their view of the members of the public as mere humans; that science and the public are separate entities; and that understanding entails grasping with the intellect. In the sections that follow, I review the basic assumptions and weaknesses of each of these two main research paradigms within PUS.

2.6.1 The Traditional/Positivist PUS

Until the late 1980s, the dominant agenda of PUS research (and practice) was shaped by problematising publics, and their cognitive processes and capabilities, thereby implying science, scientific culture, and institutions are unproblematic. Traditional PUS research has three approaches, namely: quantitative large-scale surveys, the study of mental models, and the theory of social representations. The predominant approach in the traditional PUS is the surveys approach which attempts to measure people's levels of scientific literacy (Michael, 2002). Ziman (1991) and Wynne (1991) have labelled traditional PUS as "the deficit" model because of its emphasis on defining and measuring people's cognitive knowledge of basic scientific facts (Ziman, 1991; Wynne, 1991; Miller, 1998). Over the years, research to evaluate the public's understanding of science has metamorphosed. In their review of PUS research using quantitative large-scale surveys carried out over the past 25 years, Bauer, Allum and Miller, (2007) have categorised the developments into three paradigms. These are: science literacy (from 1960s to mid-1980s), public understanding of science (1985 to mid-1990s), and science and society (from mid-1990s to the present*)* (Bauer et al., 2007). Bauer and colleagues (2007) note two things: first, developments in PUS research have largely centred on the two research paradigms: "the deficit model" and "the critical" model, and second, that theorists and researchers link the deficit model to quantitative research methodologies, while the critical model is associated with qualitative research. They point out that equating the deficit model with the quantitative protocol and the critical model with qualitative methodology is fallacious and hampers research on PUS. So, in their attempt to erase the boundary between these two research paradigms, they argue that this fallacious link must be done away with to facilitate the expansion of PUS survey research. They envision this expansion of PUS survey research moving in four directions: the contextualisation of survey research; an investigation of cultural indicators; the integration of datasets and utilisation of longitudinal analyses; and the inclusion of other data stream (Bauer et al., 2007).

2.6.1.1 Quantitative large-scale surveys

The surveys on PUS are used to gauge the levels of the public's knowledge of, and attitudes towards science, and then the findings are used to make a strong case for science education. These large-scale surveys, which have been carried out since the 1960s, have found that the public generally lack basic knowledge about scientific facts, and as a consequence display negative attitudes towards science. The quantitative surveys presume a public deficient in knowledge, attitude or trust (Miller, 2001; Bauer, et al., 2007); hence it is associated with the "deficit model". The argument advanced by the deficit model is that in order to improve the public's understanding of science, there is need to disseminate scientific information to the public. It is envisaged that this improved understanding leads to more favourable views and attitudes towards science.

The deficit model has four main assumptions. Firstly, there is an assumption that the general public lacks basic understanding of scientific facts, theories and methodologies as communicated by experts—what others have termed "textbook science". Ironically, the deficit model uses large-scale surveys to measure scientific literacy of the "scientifically illiterate public", and then uses the findings as a basis for the promotion of science education to the public. What is clear in this assumption is that the deficit model problematises the publics, and their cognitive processes and capabilities, but assumes that science and its institutions are unproblematic (Wynne, 1996). In other words, the traditional approach assumes that the public is deficient in scientific literacy, and this needs to be filled in with scientific information (Michael, 2002). Secondly, the deficit model assumes that once the public understands science, then the public will have favourable and positive attitudes towards science and technological developments. Thirdly, there is an assumption that science is a provider of solutions to the world's problems. Finally, science is portrayed by the deficit model advocates as if it were a value-free and neutral activity. In short, the deficit model emphasises the public's inability to understand and appreciate the achievements of science, and argues for the improvement of the quantity and quality of scientific information being communicated to the public. However, these assumptions have been shown to be highly questionable.

The deficit model views scientific knowledge as good for everyone. It also assumes that lay people are ignorant of science and that lay knowledge falls short of accredited scientific knowledge (Michael, 2002: 359). For the public to attain scientific literacy, this perspective advocates more science education. The central argument of the deficit model of PUS is clearly presented by the United Kingdom's Royal Society Report (1985), which states that:

> "…better public understanding of science can be a major element in promoting national prosperity, in raising the quality of public and private decision-making and in enriching the life of the individual…Improving the public understanding of science is an investment in the future, not a luxury to be indulged in if and when resources allow" (Royal Society, 1985: 9).

The above statement from the publication by the Royal Society—known as the Bodmer Report—perceives science as a solution to the social and economic problems facing humankind. The report portrays the UK public as ambivalent about science, and assumes that this is caused by low scientific literacy levels (Miller, 2001). To reverse this trend, it is envisaged that scientists need to communicate with the public about their work in order to gain public support. The argument put forward by the Bodmer Report was that increased scientific literacy would promote the general public understanding, appreciation and support of science. As a result, in the years that followed, scientists embarked on popularising science. The USA also witnessed similar campaigns. The only major difference was that in USA popularisation of science was not done by the scientists themselves but by four different groups, namely; commercial publishers, scientific societies, science journalists, and government agencies (Lewenstein, 1992).

Over the years, several scholars have criticised the deficit model for its flawed assumptions (Wynne, 1995; Miller, 2001). One strong criticism against the deficit model of PUS has been about the linking of science education, level of knowledge (or scientific literacy), and a favourable attitude towards science and technology (Bucchi & Neresini, 2008). The advocates of quantitative survey research on public attitudes towards science argued that there is a relationship between public interest in science and public attitudes towards science, on one hand, and the knowledge the public have about science, on the other. However, the critics argue such a relationship does not exist among these variables. They argue that more scientific knowledge does not necessarily lead to more trust in and support for science. Thus the correlation between scientific literacy and public attitudes towards science has been bone of contention among researchers on PUS (Allum, Sturgis, Tabourazi & Brunton-Smith, 2008).

While most of the surveys conducted in the 1960s and 70s found that the USA and the UK publics possess low levels of "textbook" knowledge about science, the respondents still held scientists in high esteem. There is also convincing evidence from other studies that the relationship between scientific knowledge and attitudes to science is weak (Evans & Durant, 1995; Bauer et al., 2007), and still other studies have found a negative relationship between them (Bucchi & Neresini, 2002).

A survey study by Evans and Durant (1995) to explore the relationship between scientific knowledge and levels of support for science among the British public found that there is a weak connection between them; generally, understanding of science among the British public was found to be weakly related to more positive attitudes, and that to some degree people's attitudes to science depended on the saliency they put on the issues. There is also evidence in the developed countries indicating that laypeople do exhibit little knowledge and understanding of biotechnological issues. Bucchi and Neresini (2002)—who carried out two surveys of representative samples of Italian adults in 2000 and 2001 on the relationship between exposure to science in the media, information on biotechnologies, trust in science, and attitudes to technologies—found that a substantial degree of scepticism and suspicion about biotechnological issues came from respondents who were most exposed to scientific communication and best informed about these issues (Bucchi & Neresini, 2002). In their analysis of Eurobarometer surveys conducted between 1992 and 2001, Miller and colleagues (2002) found that interest in science is declining while knowledge is increasing. These findings confirm previous suspicions that exposure to scientific information does not necessarily lead to greater public trust in science. This seems to suggest that familiarity with science breeds disinterest (Bauer et al., 2007). Thus, the debate on whether more scientific information would lead to interest and favourable attitudes towards science is inconclusive.

The motivation for the deficit model is that the more literate the public is about science, the more they will love, appreciate and support it. This implies that any resistance of scientific programmes by the public should be attributed to their misunderstanding of science, and that the remedy is to educate the "illiterate" public (Wynne, 1995). However, there is documented evidence that the lay public do have knowledge that scientists do not possess. Wynne's (1989) study of the interaction between scientists from the UK's Ministry of Agriculture, Food and Fisheries (MAFF) and Cumbrian sheep farmers after the Chernobyl disaster is a case in point. The 1986 Chernobyl accident deposited radioactive caesium which contaminated pasture and sheep flocks. Wynne argues that the Cumbrian sheep farmers had a great deal of knowledge about sheep farming and the local environment to the extent that they knew exactly how radioactive fallout would affect their sheep farming. The farmers advised the MAFF scientists how the sheep were to be treated to minimize the impact of the radioactivity. Nonetheless, the science experts would not take heed of the farmer's advice simply because they (farmers) lacked scientific training and credentials. This had far-reaching consequences on UK economy as a lot of sheep subsequently died. The point being made here is that the sheep farmers had lay expertise which should not have been ignored by the science experts.

Defining the nature of 'scientific literacy'[11] is core to grasping the 'deficit model' of PUS. Literally, it means having the ability to read and write about science and technology (Miller, 1998: 204). But, we may then ask: What does 'scientific knowledge' or 'science' mean? What does the term 'scientific literacy' really mean? Which methods best measure scientific literacy? Theorists have given conflicting responses to these questions. The concept of 'scientific literacy' encapsulates the main goal of the deficit model of PUS (Thomas & Durant, 1987). There has been growing concern among the advocates of the deficit model that

[11] Many scholars have attempted to define this seemingly simple concept of "scientific literacy". The concept has a long history. According to Laugksch (2000), the term "scientific literacy" was coined in the 1950s. For a brief historical and conceptual overview of the concept, the reader is referred to Laugksch's (2000) publication titled "Scientific Literacy: A Conceptual Overview." Suffice to say, it was B.S.P. Shen (1975) who categorised scientific literacy into three, namely: practical scientific literacy; cultural scientific literacy; and civic scientific literacy. Civic scientific literacy can be defined as having the ability to cognitively understand scientific terms and constructs, and also ably comprehend debates within the fields of science. Shen (1975) argues that "civic science literacy is a cornerstone of informed public policy" (Shen, 1975: 49). Generally, when scholars argue that scientific literacy is possible they mean "civic scientific literacy".

the majority of the public are not sufficiently literate in science, and the remedy has been to issue calls to raise the levels of scientific literacy. Yet, there is no consensus among analysts as to what the concept means. Surprisingly, even scientists themselves do not seem to have a unified understanding of what ‘science’ is, let alone ‘scientific knowledge’ (Wynne, 1991). According to Durant (1993: 129) scientific literacy refers to “what the public ought to know about science”. Nonetheless, the concept of ‘scientific literacy’ has a range of meanings and interpretations. Laugksch (2000) has noted that the varied meanings and interpretations of the concept of scientific literacy are influenced by a number of different factors including:

> “the number of different interest groups that are concerned with scientific literacy, different conceptual definitions of the term, the relative or absolute nature of scientific literacy as a concept, different purposes for advocating scientific literacy, and different ways of measuring it” (Laugksch, 2000: 74).

Ironically, the experts would like the public to understand science while they too do not really understand it. Wynne stresses that for us to comprehend PUS it is necessary for us to also think through the different ways in which science experts understand, interpret and represent science (Wynne, 1991: 112). This implies that lack of understanding of science cannot be blamed on the public only but on scientists as well (Wynne, 1991).

A number of theorists have attempted to articulate the nature of scientific knowledge. One of the philosophers of science, Alan F. Chalmers argued in the 1970’s that scientific knowledge is objective because science has a “scientific method” i.e., observation and experimentation (Chalmers, 1976). But, even scientists, philosophers and sociologists of science do not seem to agree on the nature of the science’s belief system and method (Shapin, 2008). Some argue that key to understanding science is its process and not its facts (Bauer et al., 2007). Still others argue that relevant scientific knowledge includes general understanding of the professional aspects of science i.e., research protocols, peer review, knowledge validation processes, scientific controversies, and the politics of science (Gregory & Miller, 1998; Bauer et al., 2007; Turney, 1996).

It may be argued that the public cannot be expected to possess as much scientific knowledge as professional scientists do (Gregory & Miller, 1998). It is therefore unreasonable for scientists to aim at creating a society composed entirely of science experts who, in turn will uncritically support the practice of science. The least that can be expected of the public could be an understanding of science as an institution and the application of science in people's everyday lives (Durant, 1987; Gregory & Miller, 1998).

The deficit model can be viewed as an exclusive approach since it regards only scientists as sole producers of 'true knowledge'. It subscribes to the prescriptive, top-down view of PUS, in which scientists are placed at the top and the public at the bottom of the ladder. It regards scientists as producers of "genuine knowledge" and brands lay people as ignorant. Thus, lay knowledge falls short of accredited scientific knowledge (Michael 2002: 359).

The deficit model assumes that public illiteracy of science is a result of lack of scientific information. But this assumption can be challenged. Public uptake of scientific knowledge cannot only be attributed to the information gap between scientists and the public. The uptake of scientific knowledge by the public may also be influenced by a host of factors, including value judgements, degrees of trust in scientific institutions, and the usefulness or relevance of scientific knowledge in solving the public's needs (Turney, 1996). As a matter of fact, scientific meaning is socially negotiated and therefore it would be a mistake to presume that scientific knowledge is superior to "lay knowledge" (Wynne, 1991; Ziman, 1991). Additionally, rejection of a scientific programme does not necessarily mean the lack of understanding of science. On the contrary, it may mean more understanding of science (Turney, 1996).

Other analysts have argued that scientific institutions and expert actors are prejudiced in their view that lay people are illiterate about science (Irwin & Wynne, 1996; Bauer et al., 2007). Admittedly, lay people do have knowledge, and this knowledge is qualitatively different from expert knowledge (Bucchi & Neresini, 2008; Michael, 2002). The deficit model is faulted for adopting a paternalistic, one-way, top-bottom communication, in which "true knowledge" must be imparted to the illiterate public. The picture of science painted here is that science produces infallible knowledge. However, we all know that as a human enterprise, science is fallible. Collins (1985) has argued that we must trust scientific advice up to a point to avoid being disillusioned with science's devastating consequences. The deficit model is mistaken to assume that there is just one 'public' of science. There is not one public but many 'publics' of science whose interests, experiences, belief and value systems need to be taken into account when disseminating scientific information (Wynne, 1991). Wynne (1995) laments that "by constructing the public as ignorant, when that public may in its own idiom be expressing legitimate concern or dissent, scientific institutions inadvertently encourage yet more public ambivalence or alienation" (Wynne, 1995: 365).

Other critics fault the methodological approach that the deficit model uses for doing research on PUS. The deficit model is equated with quantitative survey research. Quantitative surveys as tools for measuring people's scientific literacy are limited in that they fail to capture how people in different social contexts experience and construct the meaning of science (Prewitt 1982). Prewitt (1982) argues that scientists assume wrongly that the public does not know much about science, but the truth is that the scientific community is ignorant of society (or public). In other words, traditional PUS has what has been termed a 'sociological deficit'—meaning lack of a proper understanding of the public. In his scathing criticism of the large-scale quantitative surveys of PUS, Wynne (1995) argues that surveys take the respondent out of context. He writes that:

> "The survey method by its nature decontextualizes knowledge and understanding and imposes the assumption that their meaning exists independently of human subjects interacting socially. Evidence of internal coherence among survey data is not evidence of wider validity—only of internal consistency. Too often the latter is mistaken for the former" (Wynne, 1995: 370).

It is very clear that the deficit model is perceived by critics to disregard the social context of those who interact with science. Traditional PUS assumes that the meanings of science and scientific knowledge, and understanding are given, and faults the public for not understanding and applying science. This is not surprising because traditional PUS advances a mechanistic conception of people; people are conceived "as assimilators of knowledge, that is, cognitive repositories or deposit boxes in which can be stored the requisite information" (Michael, 2002: 365). Little wonder, traditional PUS is engrossed in assessing the cognitive abilities of lay people as an approach to PUS. In other words, the focus for the deficit model is "to measure the extent to which the public think like scientists" (Bauer & Schoon, 1993), and when lay people do not measure up to this they are labelled "illiterate". The large-scale surveys are deficient in capturing certain complex social issues including relational constructions of "understanding," "science," "knowledge," and "trust" (Wynne, 1995: 382). These can only be identified and explored using qualitative studies. This augments what scholars on social research methodologies have pointed out as a weakness of large-scale quantitative surveys. For instance, Babbie and Mouton point out that surveys are inherently superficial in their coverage of complex social issues (Babbie & Mouton, 2001). The observation points to the fact that surveys seldom assesses people's attitudes, orientations, circumstances and experiences of scientific knowledge and how the people reconstruct science within their local contexts.

2.6.2 The Critical/ Contextual model of PUS

Since the early 1990s, the deficit model of PUS has been subjected to strong criticism. Most criticism has come from sociologists of scientific knowledge who support what is also known as the "critical or contextual or constructivist or interpretative model." One of the distinguished scholars on PUS, Steve Miller (2001), notes that surveys conducted in the UK during the period between 1985 and 2000 to assess PUS suggest that little has been achieved by the deficit model. He argues that even after the UK's scientific community was mobilized for PUS, the British public were not 'scientised.' This is a paradox, and raises a number of pertinent questions. While some are of the view that science education is the key to improving PUS, critics find fault with this kind of approach and argue that the social context and lay knowledge also play a significant role in public uptake of scientific knowledge. Suffice to say, that PUS research is now at the crossroads.[12]

The critical model advances the view that scientists are not the only experts and producers of genuine knowledge, but that lay people too have knowledge and competencies which enhance and complement those of science experts (Wynne, 1991, 1996; Ziman, 1991; Turney, 1996; Michael, 2002). The critical approach mainly problematises science and draws from sociology, history and philosophy. Considering that for many years PUS research has been dominated by the deficit model, Wynne has made an observation that "problematising science is a central part of any serious attempt to define the overall research and public policy issues of public understanding of science" (Wynne, 1995: 384). The critical model emphasises understanding the social context and the role of lay knowledge in how scientific knowledge is assimilated and used by members of the public (Michael, 2002; Wynne, 1995). In this sense, the critical model sees members of the public as socialized people as opposed to just cognitive individuals as in the deficit model (Michael, 2002; Bucchi & Neresini, 2008). As noted by

[12] I borrow this phrase from Steve Miller whose paper published in 2001 in the *Public Understanding of Science* journal was titled "Public understanding of science at the crossroads." In this paper, Miller observes that public understanding of science as advanced by the deficit model has not yielded expected results. He also notes that The House of Lords Science and Technology Committee's report "Science and Society" (2000) encourages scientists to engage the public through dialogue, discussion, and debate about science and its implications for individuals and society.

Michael (2002), issues of trust, credibility, and understanding of social relations play an important role in people's uptake of scientific knowledge. Thus, the critical model accuses traditional PUS of having a sociological deficit (Michael, 2002).

Whereas the deficit model uses quantitative large-scale surveys to measure the public's knowledge and attitudes towards science, the critical/constructivist approach of PUS makes use of participant observation, structured in-depth interviews, and discourse analysis tools in order to study the influence of social contexts and social relations upon people's renegotiation of science (Wynne, 1995). Usually, the sample sizes are much smaller than the large-scale samples used in quantitative surveys. The critical perspective faults the deficit model for its position that there is "proper" science that needs to be understood by the public. The critical model argues that a proper understanding of PUS entails examining the various ways in which lay people's pre-existing knowledge and attitudes interact with scientific information. This model calls on scientists to take an interest in understanding lay people's social contexts. This means that scientists should no longer adopt a "top-down" approach, conceiving the public as a homogenous group, but rather scientists should adopt a "bottom-up" approach in which the expertise of lay people is also recognised (Gregory & Miller, 1998: 99). Thus the critical model advances the view that improving PUS also implies improving scientists's understanding of the public (Turney, 1996: 1088). Some studies (see Wynne's 1989, 1991, 1996; Irwin, 1995) have demonstrated that lay people do have competencies and knowledge that complement those of the science experts. For instance, Wynne's (1989) famous study of the relationship between UK's MAFF and Cumbrian sheep farmers. After the Chernobyl disaster, scientists found that the sheep farmers knew a great deal about the impact of radioactivity on their local environment and sheep farming. This study demonstrated that lay people, who did not have proper scientific training and credentials, were able to construct knowledge and renegotiate the boundaries of expert knowledge (Wynne, 1989, 1992; Carolan, 2006).

What we see in the critical model is a shift from the education of a scientifically illiterate public to the participation of the lay public in scientific discussion on the assumption that lay people have knowledge and competencies which enhance and complement those of science experts (Bucchi & Neresini, 2008). Within this perspective, lay people are also regarded as experts in their own right. Put differently, lay knowledge is not seen as impoverished or quantitatively inferior to scientific knowledge, rather it is qualitatively different (Bucchi & Neresini, 2008). Indeed, as pointed out by Collins and Evans (2002), the term "lay expertise" is an oxymoron; it means the expertise of not being an expert (Collins & Evans, 2002: 238). Lay experts, in this context, are members of the public whose technical expertise has not been recognised by degrees or other certificates (Collins & Evans, 2002: 238). Myskja (2007) has noted that the concept of lay expertise is key to concerns about public involvement in the governance of science and technology (Myskja, 2007: 1). The critical model argues that lay experts can help in the progress of science and technology.

The critical approach attempts to re-define the relationship between science and the public in a way that is not abstract but locally situated, and advances the view that both expert and lay knowledge are socially and culturally contingent (Wynne, 1995). This has been underscored by the UK House of Lords' *Science and Society* report (published in March, 2000) which embodies the contextual approach, emphasising the important role social context and lay knowledge play in how members of the public assimilate scientific knowledge (Miller, 2001). In this report, the House of Lords proposed a shift from the deficit model of PUS to the contextual approach, whereby scientists would engage the public using "the 3-D approach—dialogue, discussion, and debate"—about science and its social implications (Miller, 2001). Notwithstanding the criticism by Michael (2002) that this report is deeply ambiguous as it retains the emphasis on lay people's need to comprehend aspects of science and technology, the House of Lords report somehow embraces the contextual approach to PUS research especially with its call for science communicators to be sensitive to people's experiences, values and beliefs. As opposed to the deficit model that argues for a "top-down" approach, the critical model argues for a "bottom-up" approach (Turney, 1996; Gregory & Miller, 1998; Wynne, 1996).

The critical model has received a fair share of criticisms. One strong criticism concerns the practicality of lay involvement in decision-making in matters that are regarded as purely "scientific". The argument is that because lay people are not able to comprehend complex scientific issues, they should be excluded from participating in science. The deficit model argues that there is a clear demarcation between science and non-science, and that only those that have the expertise should engage with science. Inasmuch as the critical model seems to advance the argument for democratisation of science, it is not quite clear what the advocates mean by lay involvement in the production of knowledge. The model intimates that it supports lay people's involvement in science but does not clearly articulate what the nature of this lay involvement is. It also leaves unanswered some big questions with regard to public participation in science. Such questions include: To what extent does this participation involve lay persons in activities and decision-making commonly understood to be the exclusive realm of experts? At what point do lay people enter the process of knowledge production? And, suppose we accept the citizen-scientist interaction, who defines the nature of each group's involvement? It is quite evident that proponents for the critical model of PUS research have not addressed these methodological issues. One simple truth that needs to be emphasised is that embracing the critical model does not imply that there is no knowledge deficit (Miller, 2001: 118). Evans and Plows (2007) noted that the greatest challenge to lay involvement in matters of science relates to its practical aspects. Lidskog (2008) argues that it is proper to label citizens as "lay people" simply because they are not professionally active in matters related to science and that it is not their professional realm to contest scientific knowledge claims and elaborate on standpoints. This explains why the demarcation between scientists and lay public remains. As a matter of fact, Callon (1999) argued that even the critical model has had a fair share in promoting the demarcation, though in a more gentle, and pragmatic way.

The critical model is also faulted for "practicing a lay or naïve political science and suffering from a political science deficit" (Michael, 2002: 363). The argument put forward is that if put into practice, the critical approach would also invalidate the distinction between state and civil society (Michael, 2002). The critical model seems to suggest that reality is socially constructed and so it can easily be changed. However, we all know that it is hard to change social institutions. Social institutions such as science, the state, the church, and others are well established in our society and play a very important role in society, to the extent that one cannot fathom living in a modern democratic society without them.

2.6.3 Heterogeneous PUS

Heterogeneous public understanding of science is a "new" paradigm that was developed by Mike Michael (2002), and came out of his critique of the two models of PUS, namely the positivist/traditional approach and the critical/interpretationist approach. Heterogeneous PUS can be viewed as a modification of critical PUS. Like the two perspectives on PUS, heterogeneous PUS attempts to reconceptualise the three terms of PUS and the relations between them.

In his analysis of the two dominant research paradigms on PUS, Michael (2002) has noted that although the traditional and critical models on PUS differ markedly in terms of their conceptualisations of the public, science, and understanding, they nonetheless do have some common features. Some of the commonalities they share include their emphasis on the member of the public as pure human person; they both presuppose that science and the public are separate entities; and that understanding entails the process of grasping with the intellect (Michael, 2002). By drawing out the implications of these conceptualisations on PUS research, Michael (2002) almost aligns his paradigm with the critical model.

Heterogeneous PUS attempts to reconceptualise the notions of 'public', 'understanding', and 'science'. According to Michael (2002), the public should not only be understood in humanistic terms but as hybridic i.e., humans and technological nonhumans interact with each other almost on a daily basis. The humanism of traditional PUS assumes members of the public are assimilators of knowledge, while that of critical PUS conceives members of the public as socialized humans (Michael, 2002). Michael's conceptualisation of the public consists of both natural humans and technological nonhumans. Michael (2002) draws on the actor-network theory as espoused by Bruno Latour (1993) and John Law (1994). The two theorists have argued that technologies such as telephone, aeroplanes, fax machine, computers, desk, and light have become a part and parcel of daily lives of humans. Arguably, technological artefacts have become members of human community. Nowadays it is almost impossible for humans to do anything without the use of technology, and therefore "to be human means to be hybrid" (Michael, 2002). This being the case, understanding the public entails understanding how humans interact with technologies.

According to heterogeneous PUS, understanding does not mean comprehension (assimilation of scientific knowledge by the human mind) nor apprehension (uptake of scientific knowledge depending on the trustworthiness of sources of knowledge, credibility of information and issues relating to social identity) but 'prehension'. Michael (2002)—drawing on Whitehead's (1929) metaphysics of the organism—argues that prehension comes first before comprehension and apprehension (Michael, 2002). Michael (2002) quotes Whitehead's (1929) definition of prehension as follows, "the multitude of heterogeneous ways in which an entity is attached to, and emerges out of, the external world" (Whitehead, 1929). From this definition, Michael (2002) argues that apprehension "connotes both a message that travels to an existent subject (or receiver or actor) and a message that partly (re)constitutes the subject, which serves in its emergence or 'becoming' " (Michael, 2002). Michael (2002) further argues that prehension points to the materiality of the message, senders as well as receivers.

Finally, heterogeneous PUS embraces critical PUS's conceptualisation of the relation between science and the public; that scientific knowledge is interwoven with non-scientific knowledge. While the traditional PUS keeps science and non-science as separate entities, critical PUS views lay knowledge and scientific knowledge as complementing each other. Indeed, heterogeneous PUS can be viewed as an improved version of critical PUS. At a more theoretical level, Michael (2002) argues that traditional, critical and heterogeneous PUS can co-exist. However, it remains to be seen how practical this can be. Arguably, heterogeneous PUS has underscored the need to erase the boundaries between science and the public. This could only be done if science is fully democratised, that is, allowing citizens to participate in science.

Michael's endeavour to critique both the traditional and critical PUS has been applauded by José van Dijck (2002). José van Dijck, an expert on media studies, has described Michael's theoretical framework of heterogeneous PUS as "a laudable adjustment of our theoretical theses to the epistemology of everyday life" (Van Dijck, 2002). Nevertheless, Van Dijck (2002) points out that Michael's notion of 'prehension' which emphasises the active participation of experts and audience (or lay people) in the production of scientific knowledge is "too weak to define the role of 'audience' (or consumer) in the construction of scientific knowledge" (Van Dijck, 2002). José van Dijck (2002) notes that Michael's heterogeneous PUS is not clear on the role media technologies, such as the Internet, play in making scientific information accessible to the majority of the lay public. Through media technologies, argues Van Dijck, the lay public are able to search scientific knowledge and request interpretation on scientific issues. This means that scientific knowledge "is no longer passively disseminated but actively negotiated" by the audience of science (Van Dijck, 2002: 9). Additionally, the audience of science is very complex and heterogeneous and scientists need to understand and appreciate this; the audience has overlapping identities including social, racial, sexual, religious, intellectual, and political (Van Dijck, 2002). Obviously, this makes more sense since science does not have one homogenous public but a heterogeneous public, and in this we can talk of science as having many publics.

Probably the most scathing criticism on PUS research by Van Dijck relates to the usage and connotations of the term 'public understanding of science'. Van Dijck argues that the use of term 'public understanding of science' assumes two things: first, it assumes an implicit hierarchy between experts and the illiterate in which scientific knowledge is highly regarded when compared to lay knowledge, and second, the term assumes that once the public understands science then the public will become literate in science, and hence the gap between scientists and lay people will be bridged. This reasoning is very simplistic. Inadvertently, PUS reproduces the hierarchical distinction between science experts and lay public. Van Dijck proposes that instead of using the term ‘public understanding of science’, we should be talking about ‘science communication’. Communication is an interactive process; it is a two-way process. It means that communicators should not only be preoccupied with the message they are communicating, but also listen attentively to and understand the audience. Thus, science communication can be defined as the transference of scientific knowledge to the public and assessing the impact this information has on the public by way of feedback. More recently, science communication has become an academic discipline equipping both scientists and non-scientists with knowledge and skills on how well science can be communicated to/with the public. There are two major goals for communicating science: to increase the public’s understanding of science (or scientific literacy), and to promote the public’s interaction with science (Logan, 2001).

2.7 Public participation in science

Increasingly, there are calls for science to be democratised. ‘Democratisation of science’ is implied by the critical model of PUS (Michael, 2002; Collins & Evans, 2002; Bucchi & Neresini, 2008), and entails allowing public participation in decision-making and production of knowledge processes in the practice of science (Berk, [1986] 1992; Kleinman, 1998; Carolan, 2006; Lidskog, 2008). The concept of public participation is difficult to define because a number of academic fields make claim to it, and so its boundaries are blurred. Nonetheless, Bucchi and Neresini (2008) define public participation in science as “the diversified set of situations and activities, more or less spontaneous, organised and structured, whereby non-experts become involved, and provide their own input to agenda setting, decision-making, policy forming, and knowledge production processes regarding science” (Bucchi & Neresini, 2008: 449).

The participation of members of the public in science and technology issues has been theorised and promoted by scholars belonging to a meta-scientific discipline known as Science and Technology Studies (STS) (see Irwin & Wynne, 1996; Stirling, 2005, 2008, 2010; Chilvers, 2010, 2012; Macnaghten & Chilvers, 2014). Public participation or engagement with science has many faces. It has been conceptualised to include “citizen participation,” “inclusive deliberation,” or “stakeholder dialogue” and it takes place both in and with various publics (Stirling, 2010). Stirling (2010) notes that as far as public engagement with science is concerned, the basic question that is yet to be answered is "Why engage the public on scientific and technology choices?" This question has received a wide range of reasonable but contesting responses. However, there is consensus among theorists that public engagement with science entails shifting from "top-down," "closing down," "linear and deterministic" approaches to more "inclusive," "opening up," "discussive" "pluralistic," "refective" and "participatory" approaches (Stirling, 2010; Chilvers, 2012, 2014). Stirling (2010) argues that opening up the governance of science and technology to the publics is a key feature of "knowledge society" and more consistent with procedures for democratic political accountability. The works of Stirling (2008, 2010) and Givers (2012, 2014) seem to suggest that public understanding of science is two-pronged; members of the public endeavour not only to understand science but also co-produce scientific knowledge, and scientists attempt to open up science to the public).

Bucchi and Neresini (2008) have conceptualised an interpretative framework for public participation in science and technology. This interpretative framework includes sponsored as well as spontaneous forms of participation. Examples of sponsored forms of participation in science include referenda, science shops, public hearings or inquiries, public opinion surveys, negotiated rule-making, consensus conferences, and citizen juries, while public mobilization and protests, and patient associations, are examples of spontaneous forms of participation. The underlying feature in all sponsored and institutionalised forms of public participation is that they are selective, that is only sections of the public are welcome to take part. The logic of public participation in science is that demarcations between scientists and laypeople are broken down when laypeople and scientists become co-producers of knowledge. However, some of these forms of public participation in science end up reproducing the hierarchical demarcations between science and the public. Indeed, just to echo Lidskog's (2008) caution, it is imperative that public inclusion in science should always aim at democratisation of science and not to serve as a means of educating the public in science and legitimating scientific decisions (Lidskog, 2008).

2.8 Conclusion

This review has discussed at length the two major approaches to PUS research, namely: the deficit model and the critical model. Not only has this review discussed the arguments put forward by the two approaches, but an attempt has also been made to articulate their respective weaknesses. From the analyses it is clear that though these two models are very different and even incompatible approaches. It has been noted that instead of closing the gap between science experts and the public, the two models assume that science and the public are discrete entities.

On the one hand, the deficit model posits that lay people lack scientific knowledge, and therefore need science education to improve their understanding of science. The critical model, on the other hand, argues that lay people do have expertise and competencies that can complement those of science experts. In this way lay people are recognised as producers of scientific knowledge, and "local knowledge" is not considered inferior to knowledge generated by science experts. Furthermore, quantitative large-scale methodologies are employed for the deficit model, whereas the critical model uses the qualitative methodologies.

Analyses of the traditional and critical approaches on PUS research also reveal that science and the public are considered discrete entities. Much as the critical model attempts to erase the boundaries between the experts and the public by calling for the democratisation of science, this proves to be a very difficult undertaking as in the end the demarcations are reproduced. The major challenge for critical PUS remains articulating the nature of lay involvement in matters that are traditionally thought to be exclusive to scientists.

Large-scale surveys carried out in the USA and the UK since the 1950s show that public literacy levels were low. Similar results were found in many other countries where these surveys were conducted. This seemed to provide strong evidence for the need for more science education. Since then scientists and the scientific institutions have tirelessly devoted themselves to science education of the general public. However, these efforts have not produced the expected results by improving public understanding and appreciation of science. This is really a paradox. To solve this paradox, constructivists advocated for more qualitative research in order to grasp the issues that influence the public's uptake of scientific information. There is some evidence emerging from these studies that understanding of science is influenced by the sociological and other related factors. Constructivists argue that the public uptake of science cannot be separated from issues of trust, credibility of knowledge sources, and social relations. The bottom line here is that the lay public do have knowledge that cannot be ignored by the science experts and that experts do not know everything. This has implications on how the relationship between scientists and lay people should be negotiated and developed.

Reading this review, it is quite evident that in order for us to have a proper understanding of PUS we need to devote attention to defining the terms embedded in the notion of 'public understanding of science', namely: 'public', 'understanding', and 'science'. How one defines each of the three notions determines how one conceptualises the relationship between science and society (or the public). In other words, the various ways in which theorists understand, interpret and represent 'science', 'the public', and 'understanding' has serious implications on the research approach they adopt for addressing PUS. For example, if one defines the term 'public' as 'non-scientific public or lay people', one is likely to problematise the public and label them "scientifically illiterate," and one would probably then adopt the deficit model. Conversely, if one conceives 'the public' as consisting of socialised humans who possess invaluable local knowledge, then one would automatically adopt the critical model. The reason why debates on PUS are often intense and inconclusive is because scientists and their critics have divergent definitions of the three terms of 'public', 'science' and 'understanding'. While critical PUS problematises science, the deficit model problematises the public. Heterogeneous PUS developed by Michael (2002) can be viewed as a modified version of the critical approach, and it is not without its shortfalls. Arguably, we need to reconceptualise PUS. This new conceptualisation should embrace the elements of both the deficit and critical approaches to doing PUS research. In other words, PUS research ought to be two-pronged: the lay public making an effort to understand science, while at the same time scientists and scientific institutions endeavouring to understand the public and the social context within which scientific knowledge is negotiated, and most importantly, allowing lay people (both educated and uneducated) to participate in science. Thus, I argue that the deficit and critical models of PUS are not in competition and incompatible, but rather two sides of the same coin. In other words, these two models can complement each other. This endeavour should aim at developing an approach that does not reproduce the dichotomy between science experts and the public but rather allows scientists and members of the public to talk with each other.

CHAPTER 3

PUBLIC UNDERSTANDING OF GLOBAL CLIMATE CHANGE: EMPIRICAL RESEARCH FINDINGS AND ANALYSES (LITERATURE REVIEW)

3.1 Introduction

This chapter reviews the literature on empirical studies that have been conducted on public understanding of global climate change. The review indicates that rigorous empirical research on public understanding of climate change began in the early 1990s, mostly conducted in USA and Europe (e.g., Kempton, 1991; Kempton, Boster & Hartley, 1996; Bostrom, Morgan, Fischhoff & Read, 1994; Read, Bostrom, Morgan, Fischhoff & Smuts, 1994; Bord, Fisher & O'Connor, 1998; Bord, O'Connor & Fisher, 2000; Krosnick, Holbrook & Visser, 2000; Lorenzoni & Langford, 2001; Leiserowitz, 2003; Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006; Lorenzoni, Leiserowitz, De Franca Doria, Poortinga & Pidgeon, 2006; Lorenzoni, Nicholson-Cole & Whitmarsh, 2007; Brody, Zahran, Vedlitz, A. & Grover, 2008; Dunlap & McCright, 2008; Whitmarsh, 2009; BBC WST, 2010; Reynolds et al., 2010; Weber, 2010; Brechin & Bhandari, 2011; Weber & Stern, 2011; McCright & Dunlap, 2011; McCright, 2011; Poortinga, Spence, Whitmarsh, Capstick & Pidgeon, 2011; Spence, Poortinga, Pidgeon, 2011; Egan & Mullin, 2012; Smith & Leiserowitz, 2012; Wibeck, 2014). While some studies focussed on assessing public understanding of scientific "facts" about climate change (e.g., Bostrom et al., 1994; Read et al., 1994), few (e.g., Eurobarometer 2009; Bord et al., 1998; O'Connor et al., 1999) have investigated perceptions, beliefs and attitudes of the public towards climate change and the factors underlying these. A review of studies on PUS shows that the major challenge for research on public understanding of climate change has not only been the focus of investigation but also methodology used. Most of the studies employed quantitative methodology (largely using closed-ended survey instruments) (e.g., Whitmarsh, 2009; Eurobarometer 2009; 2011), some (e.g., Kempton, 1991; Stoll-Kleemann, O'Riordan & Jaeger, 2001; BBC WST, 2010; Wibeck, 2014) used qualitative methodologies (i.e., ethnographic interviews and focus group discussions), and a few others employed mixed methodology (e.g., Whitmarsh, 2005).

This chapter is organised as follows: Section 3.2 presents a scientific perspective to climate change issue. Section 3.3 zeroes in on global concern about climate change. Section 3.4

contextualises the discussion by drawing the attention of the reader to an area of research that has come to be known as "public understanding of climate change". Section 3.5 reviews studies that investigated factors that influence public perceptions, beliefs and attitudes towards climate change. This section forms the bulk of the chapter and enables us to appreciate the scope of the work that has been done by researchers on public understanding of climate change. Section 3.6 reviews the discourse on climate change in Malawi. Section 3.7 identifies some gaps regarding public understanding of climate change research. Lastly, Section 3.8 sums up the review.

3.2 Scientific understanding of climate change

Arguably, climate change is one of the greatest challenges of the 21st century (IPCC, 2013; Leiserowitz, 2007; Eurobarometer 2009, 2011). Yet it is a complex scientific phenomenon that is misunderstood not only by the majority of the public but also by some members of the scientific community. Climate change is defined by the Intergovernmental Panel on Climate Change (IPCC)—an organisation established by the United Nations in 1988 to review and assess peer-reviewed and published scientific literature on climate change, its costs, impacts and possible policy responses—as "any change in climate over time, whether due to natural variability or as a result of human activity" (IPCC, 2007a: 2).

Climate refers to the average weather conditions over a long period of time, ranging from months to scores of years. The climate system is a product of complex interactions between the atmosphere, land surface, hydrosphere, cryosphere and biosphere (IPCC, 2013). Under normal circumstances, the sunlight energy is absorbed by the earth's surface. The earth's temperature is maintained because this energy is re-radiated to space as infrared or long-wave radiation (Raval & Ramanathan, 1989). The greenhouse gases (e.g., water vapour, carbon dioxide, methane, nitrous oxide and ozone) naturally present in the atmosphere somehow act as a partial insulator preventing all the heat from being radiated back into space, thereby retaining most of the energy within and keeping the earth's temperature slightly higher than would have been the case (Lin, 2009). Greenhouse effect is thus the infrared radiated energy that is trapped by clouds and greenhouse gases in the atmosphere (Raval & Ramanathan, 1989). The natural greenhouse effect is magnified when more greenhouse gases are further released and accumulate in the atmosphere. This causes more heat to be trapped by the atmosphere (i.e., clouds and greenhouse gases) rather than being allowed to escape into space. Numerous human activities such as combustion of fossil fuels and deforestation are blamed for the increased greenhouse effect as more carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide are released into the atmosphere causing climatic variability.

Climate change by its nature is a global problem. It means that the solution to the challenge of climate change lies in the cooperation of all stakeholders worldwide (Moser & Dilling, 2007; Grundmann, 2007). A significant proportion of the world's population is sceptical about the existence of climate change, and still others are uncertain that climate change is happening. While others believe that climate change is to a larger extent anthropogenic, there are some who still believe that climate change is caused by entirely natural occurrences. However, there is consensus among climatologists that climate change is largely caused by anthropogenic activities and that its consequences are dangerous (IPCC, 2013). Scientists, policymakers and science communicators therefore argue that in order to address climate change, it is important to raise public awareness of the climate change issue so that they can understand it and respond to it in an environmentally sustainable manner.

There is also a need for a strong political will if we are to deal with climate change. It is imperative that national governments should take a leading role in formulating policies to mitigate climate change. But the formulation of climate change policies requires policymakers and the scientific community to better understand the factors that influence lay public's understanding of climate change. An investigation of factors that influence people's perceptions, beliefs and attitudes towards climate change helps us to understand and appreciate why people support or oppose measures and policies to mitigate climate change (Leiserowitz, 2005).

The climate change issue has attracted serious international attention, particularly since the late 1980s. Two explanations can be offered as to why climate change issue took centre stage during this period. Firstly, by the late 1980s climate scientists had established a correlation between human activities and climate variability, and hence began to sound a warning to humanity that certain human activities pose a serious threat to the future of both human and non-human lives. Secondly, during this period—because some media dramatized the issue of climate change, labelling it as a "climate catastrophe"— most national governments began to recognise global climate change as a policy problem (Weingart et al., 2000). It is encouraging to note that public interest in climate change has grown over the years. The public are beginning to understand the science of climate change and related issues, and policymakers and science communicators are becoming aware of the need to understand how the members of the public assimilate and renegotiate scientific information.

3.3 Global concern and awareness about climate change

The IPCC acknowledges that developing countries are the most vulnerable to the impact of climate change as they do not have the capacity to deal with the impact (IPCC, 2013). Vulnerability to climate change is viewed from two angles: vulnerability to the physical changes brought about by climate variations; and socioeconomic vulnerability as people attempt to adapt to the impact of climate change. It is estimated that over 2.8 billion people are physically vulnerable to climate change while 4 billion people (60% of the world's population) are vulnerable to climate change and variability in socioeconomic terms (Global Humanitarian Forum, 2009). Perhaps, it is also fair to assert that the world's developing countries are the most affected by climate change, yet are least responsible for causing it (Global Humanitarian Forum, 2009; BBC WST, 2010).

The 2007 IPCC report ascertains that humans are responsible for the emissions and concentration of greenhouse gases in the atmosphere that cause climate change. The majority of the world's adult population[13] is aware of climate change (Pugliese & Ray, 2009). Yet, a majority of world population— including the highly-educated—does not seem to understand the causes and effects of climate change (Bostrom et al., 1994; Read et al., 1994; Brechin, 2003; Reynolds et al., 2010). Most of the studies conducted in the USA, show that while most American citizens (who are among the most educated people in the world) cannot identify the primary causes of climate change. This is quite disturbing considering that the key to mitigating climate change is knowledge of its causes (O'Connor, Bord, Yarnal & Wiefek, 2002).

Misunderstanding of the climate change issue, coupled with other factors, has contributed to the continued increase in carbon dioxide (CO_2) emissions into the atmosphere—the primary

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[13] Between 2007 and 2008 Gallup conducted a comprehensive representative survey study to investigate people's awareness and opinions about climate change. Gallup surveyed a total of 206, 193 people from 127 countries, and this represented over 90% of the world's adult population i.e., those aged 15 and above. Gallup weighted each country's data by population to get global and regional estimates (see http://www.gallup.com/poll/117772/Awareness-Opinions-Global-Warming-Vary-Worldwide.aspx; also see A. Pugliese, and J. Ray. "A heated debate: global attitudes toward climate change" in *Harvard International Review* 30 (2009): 64).

cause of climate change. According to the International Energy Agency's (IEA)[14] 2011 statistics for CO_2 emissions from fuel, China—whose population accounts for 24% of the global total—is now the world's largest emitter of CO_2 (emitting 4.85 tons per person per year); followed by the USA emitting 19.10 tons of CO_2 per person per year, but has less than 5% of the global population; and India with 17% of world population is the world's third largest emitter of CO_2 at 1.18 tons per person per year (International Energy Agency, 2011). In comparative terms, an average American citizen emits far more CO_2 into the atmosphere than an average Chinese or Indian citizen. These statistics are quite worrisome and suggest an urgent need for people to change their lifestyles in order to reduce carbon dioxide emissions into the atmosphere. Ironically, studies indicate that the public in countries that are the most responsible for emitting too much carbon dioxide and other greenhouse gases into the atmosphere are less concerned about climate change than those who are least responsible for causing climate change. A study by Sandvik (2008)—comparing public concern about climate change across 46 countries—found that concern about climate change negatively correlates to national measures of wealth (i.e., GDP) and carbon dioxide emissions. Thus, the proportion of a country's population that perceives climate change as a serious problem decreases with increasing GDP.

The literature on public views of climate change reveals that there are high levels of awareness about climate change by the majority of the world's adult population (Lorenzoni & Pidgeon, 2006; Pugliese & Ray, 2009), and that those who are aware of climate change issues are more likely to agree that climate change is a threat to human kind (Pugliese & Ray, 2009; Eurobarometer, 2011). Most people in USA and UK have heard of either 'climate change', 'global warming' or the 'greenhouse effect'; only 1% of the English public have not heard about these terms (Lorenzoni et al., 2007). However, recent surveys indicate there is gradual decline in climate change concern among the public in many countries including USA and UK (Dunlap & McCright, 2008; Sandvik, 2008); Eurobarometer, 2009; Pidgeon, 2010). Paradoxically, despite some findings showing widespread public awareness and general concern about the issue, this has not translated into specific behavioural responses. As a matter of fact, only a minority of the UK and USA general public are committed to reducing

[14] International Energy Agency (IEA) is an autonomous organisation established in November 1974. Its primary mandate is two-fold: to promote energy security among its 28 member countries through collective response to physical disruptions in oil supply, and to provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its member countries and beyond (see http://www.iea.org).

their energy consumption (Norton & Leaman, 2004; Leiserowitz, 2006; Lorenzoni et al., 2007).

There are many reasons why the UK and USA publics do not consider climate change a serious threat when compared to other environmental problems. Firstly, climate change is not considered a major environmental concern (Lorenzoni & Pidgeon, 2006; Lorenzoni, et al., 2007). In fact, other environmental problems such as hazardous waste, water and air pollution, loss of plants/animals are rated higher than climate change, probably because these affect people's wellbeing. Secondly, the public considers other socioeconomic issues such as health and security more important than environmental issues (Bord et al., 1998; Bord et al., 2000; Norton & Leaman, 2004). Thirdly, for most people climate change is far removed in space and time, hence it is not a prominent personal threat (Lorenzoni & Pidgeon, 2006). When climate change is compared to other environmental and socioeconomic issues, people do not consider it a priority. Lastly, some sections of the global public, especially Americans, perceive climate change as a moderate risk whose dangerous impacts will be mainly felt by geographically and temporally distant people and places (Leiserowitz, 2005).

Studies on public understanding of climate change conducted in USA and UK have found widespread awareness of the issue and a general concern, but limited behavioural response (Lorenzoni et al., 2007). Recent polling indicates a gradual decrease in concern about climate change in many nations (Pidgeon, 2010). Other studies have found that while most people seem to be aware of climate change, they barely understand the causes, consequences and solutions to climate change (Lorenzoni et al., 2007). One may argue that while there is general awareness of climate change, however, there is little concern about the issue. Indeed, tackling climate change among the European public is seen largely as the responsibility of national governments, the European Union, and business, with only 21% expressly stating that it is an individual's responsibility (Eurobarometer, 2011). It is important that the world population should understand the causes, impacts and ways of mitigating climate change. But equally so, is the translation of this knowledge into appropriate action to mitigate climate change.

3.4 Public Understanding of climate change research

Today, there is consensus among scientists that climate change is largely caused by anthropogenic interference with the climate system (see IPCC Reports, 1990, 1996, 2001, 2007, 2013). While scientific evidence accumulated through observational data; the formation, testing and refinement of hypotheses, the construction of models and theories for knowledge synthesis; and the testing of hypotheses, theories, and models about climate change has been documented, and consensus among the scientific community has been reached saying that climate change is largely influenced by anthropogenic activities, the public's understanding of climate change has not drastically changed, and to some extent has even become more polarised (Weber & Stern, 2011). The public's understanding of climate change continues to be shaped by many factors including socio-demographic and psychological factors.

Admittedly, scientists should be given credit for so much experimental scientific research on climate change. For more than 150 years scientists have attempted to identify and document certain human activities as factors leading to climate change and have rightly sounded a warning to humanity, arguing that these human activities pose a serious threat to the future of both human and non-human lives (Weber & Stern, 2011). Some archaeological research has attempted to unravel the relationships between climate and past human culture. These studies have provided evidence that indeed present-day temperatures are higher than any since the Medieval Warm Period. For instance, the IPCC noted that changes in the climate are a result of the concentration of greenhouse gases in the atmosphere. The primary source of increased concentration of greenhouse gases in the atmosphere is human activities such as fossil fuel, land use and agriculture. Carbon dioxide is the most important anthropogenic greenhouse gas. Other greenhouse gases include methane, nitrous oxide, and hydrocarbons. The IPCC (2013) argues that presently there is overwhelming evidence that climate change is largely anthropogenic and that its impact is irreversible.

While the IPCC has established itself as the international authoritative body on the issue of climate change, other 'contrarian' scientists and sceptics are of the view that the IPCC misrepresents the state of knowledge and exaggerates the magnitude and urgency of the issue (Grundmann, 2007). In fact, some sceptics particularly in the USA argue that climate change is the result of natural occurrences and that humans ought not to be alarmed by its perceived catastrophic consequences. This view has been embraced by many, including some members of the American public. For instance, a survey conducted in the USA in 2009 by Pew Research Center found that while 84% of scientists said the globe was warming due to anthropogenic activities such as burning of fossil fuels and land use, only 49% of non-scientists held this view (Weber and Stern, 2011). Gallup polls conducted in the UK in 2007 and 2008 found that only 48% of the UK public held the view that climate change is anthropogenic. Thus, to some people climate change remains a controversial issue.

In explaining the mismatch between the scientific understanding of climate change and the American public's understanding of climate change, Weber and Stern (2011) posit that physical, psychological, and social factors together come into play. Firstly, they argue that climate change as a physical phenomenon is intrinsically difficult to understand. There are some fundamental attributes of climate change such as its causes and impacts that are not only invisible but also geographically and temporally distant for most people, making the phenomenon difficult to understand. Secondly, scientists and non-scientists have different ways of understanding climate change and its attributes. While scientists use multiple systematic methods to gather scientific evidence about climate change, non-scientists use personal experience and judgement shaped by affect, values, and worldviews to explain climate change. Thirdly, the American public and other publics get a lot of information about climate change generally from intermediary sources such as the mass media, the Internet, and informal conversations, rather than from climate scientists and more often than not, the information from these sources is biased, exaggerated, or distorted to promote other interests.

Public understanding of, and concern about climate change, and the translation of that knowledge into concrete action is influenced by a number of factors. While some studies (e.g., Ohe & Ikeda, 2005; Bord et al., 2000; O'Connor et al., 2002) argue for the need for improved access to climate change information, other studies (e.g., Sandvik, 2008; Stoll-Kleemann et al., 2001; Slimak & Dietz, 2006; Weber & Stern, 2011; Li, Johnson & Zaval, 2011; Egan & Mullin, 2012) have pointed out that awareness and concern over climate change is not only a function of scientific information but is also influenced by sociological, psychological and geophysical factors. It is argued that these factors play a major role in people's willingness to acknowledge the existence of climate change, and their support for climate change policies.

In the sections that follow, I discuss some of the socio-demographic, socio-structural, psychological and geophysical factors that have been identified as influencing people's perceptions, beliefs and attitudes towards climate change.

3.5 Factors that influence public perceptions, beliefs, and attitudes towards climate change

Analyses of empirical studies on public views about climate change indicate that some of the research has concentrated on investigating and assessing lay understanding of basic scientific facts about global climate change. Other studies have attempted to investigate factors that influence people's understanding of climate change. These studies suggest that attitudes, beliefs and perceptions about climate change are influenced by sociological, economic and psychological factors (Kempton, 1991; Bord et al., 2000; Krosnick et al., 2006; Lorenzoni & Pidgeon, 2006; Sandvik, 2008; Leiserowitz, 2003, 2005; Whitmarsh, 2003, 2005; Zahran et al., 2006). Unfortunately, all these studies have been conducted in Europe and USA. Surprisingly, some studies show that although a majority of people in developed countries are aware and knowledgeable about climate change, concern about climate change is moderate (O'Connor et al., 1999). Certainly, there is need for similar studies in developing countries which are considered to be most vulnerable to climate change effects. This study is an attempt to investigate factors that influence Malawians' beliefs, attitudes and perception about climate change. The understanding of factors that influence people's perceptions, beliefs and attitudes towards climate change helps us to understand and appreciate why people would support or oppose measures and policies to mitigate the change (Leiserowitz, 2005). In the sections that follow I present a review of the several factors that influence the public understanding of climate change.

3.5.1 Socio-demographic variables

A substantial body of literature indicates that socio-demographic variables including levels of education, gender, race and ethnicity, occupation, and income levels influence public perceptions, beliefs and attitudes towards and support for climate change policies (Bord et al., 1998; O'Connor et al., 1999, 2002; Sturgis & Allum, 2004; Leiserowitz, 2005; 2006; 2007; Lorenzoni & Pidgeon, 2006; Zahran, Brody, Grover & Vedlitz, 2006; Sterman & Sweeney, 2007; McCright, 2009, 2010; Semenza, Hall, Wilson, Bontempo, Sailor & George, 2008; Pidgeon, 2010; Shwom, Bidwell, Dan & Dietz, 2010; Eurobarometer, 2009, 2011). In the sections below, I discuss some of these findings on the relationship between these socio-demographic variables and perceptions about climate change and willingness to take action to mitigate climate change.

3.5.1.1 Age

Hitherto, research conducted to investigate the influence of age on environmental risk perceptions has shown conflicting results. While some studies show that age has a positive effect on perceptions of ecological risk (Lazo, Kinnell & Fisher, 2000), other studies (Dietz, Stern & Guagnano, 1998; Guber, 2003) report that age has a negative effect on the perception of ecological risk. A study by Slimak and Dietz (2006) shows that age has a weak positive effect on the perception of both chemical and biological risks, but no effect on global and ecological risks. Another study conducted in 30 European countries (Eurobarometer 2011) found that one's understanding of climate change correlates negatively with one's age; thus respondents aged 55 years and above felt significantly less informed about climate change than their younger counterparts. In the same study, it was found that these older respondents are less likely to consider climate change a very serious problem as compared to the younger respondents. These findings are consistent with those found in other studies (Kellstedt, Zahran & Vedlitz, 2008; Eurobarometer, 2009; Malka, Krosnick & Langer, 2009). Other studies found no statistically significant influence of age on concern about climate change (Wood & Vedlitz, 2007; Semenza et al., 2008).

There appears to be a relationship between age and willingness to change behaviour, as well as support for government policies to deal with climate change. Some studies (for example Bord et al., 2000 O'Connor et al., 1999; Semenza et al., 2008) found that older respondents are more likely to vote for government policies to address climate change than younger respondents, who in turn are significantly more likely to change their behaviour to mitigate climate change. This is expected, simply because younger individuals consider climate change as a much more serious threat than the older individuals (see Eurobarometer 2009, 2011). A study by Fortner, Lee, Corney, Romanello, Bonnell, Luthy, Figuerido & Ntsiko (2000) found a moderate negative correlation between willingness to act on climate change and age. Again, these somewhat conflicting results call for more in-depth research on the link between age and risk perceptions, and willingness to take action against climate change.

3.5.1.2 Gender

Studies on environmental risk perceptions indicate that men and women perceive them differently; women express greater concern and willingness to take action to address these problems than men (Mohai, 1992; Davidson & Freudenburg, 1996; Slovic, 1999 Slimak & Dietz, 2006). For the most part, these findings also hold for climate change. Until recently, few researchers paid attention to the complex interactions between gender relations and climate change perceptions (Bord et al., 1998; O'Connor et al., 1999; Krosnick, Holbrook & Visser, 2006; Leiserowitz, 2006; Brody et al., 2008; Hamilton, 2008; Semenza et al., 2008; Malka et al., 2009; McCright, 2010). All but one study (Krosnick et al., 2006) indicate that women are more concerned about climate change than men. O'Connor and colleagues (1999) found that women perceive climate change as a more serious threat and tended to be more willing to take voluntary steps to reduce greenhouse emissions than men who prefer to support government policies to address climate change. These findings are consistent with other studies (Bord & O'Connor, 1998; Bord et al., 2000; Leiserowitz, 2006; Brody et al., 2008; Semenza et al., 2008; McCright, 2010). It appears that men probably feel more comfortable with the political world and women prefer personal approaches to solving perceived environmental risks (O'Connor et al., 1999). However, this is not supported by a study by Zahran et al. (2006) who found that women are more supportive of policies to address climate change than men, and some studies indicate that there is no statistically significant relationship between gender and concern about climate change (Krosnick et al., 2006). These inconsistencies suggest the need for further research on the relationship between gender and perceptions about climate change.

There also seems to be a relationship between gender and climate change knowledge (perceived or assessed). The Eurobarometer (2009) study found that while men report that they are better informed about the causes, consequences and ways to combat climate change, women are the ones who consider climate change a more serious problem. There seems to be a general argument that women are more emotionally attached to the environment than men. This argument emanates from two theoretical perspectives: firstly, the influence of gender socialisation, and secondly, the influence of the differentiated social roles performed by men and women in society (McCright, 2010). Of course, this is not exclusive to studies conducted in USA and Europe. Women in developing countries also perceive climate change as risky. The IPCC (2007) assert that though climate change affects men and women, however women (especially those living in rural areas) in developing countries are one of the groups most vulnerable to its effects. Elaborating on this, Terry (2009) writes:

> "This is because they are often dependent on natural resources for their livelihoods, do most of the agricultural work, and are responsible for collecting water and fuel [firewood]. Climate change is widely predicted to affect all these areas of women's lives adversely" (2009: 3).

Terry's (2009) observation on the differentiated roles of men and women in developing countries is supported by findings from other studies. For example, a study by Kakota, Nyariki, Mkwambisi & Wambui (2011) investigating the interactions between gender issues, climate variability and household food security in the developing country of Malawi found that exposure and sensitivity to climate change risks varies between men and women, as women tend to be more vulnerable to its risks here than men; hence men and women respond and adapt differently to climate change risks. As a recommendation, the researchers point out "the need for policies and interventions to consider gender vulnerabilities and strengthen households' resilience to climate variability" (Kakota et al., 2011). It is worth noting that these gender roles relate to context and are heavily influenced by local culture. Certainly, perceptions of climate change are indeed heavily influenced by gender roles and relations.

A study by McCright (2010) attempted to test theoretical arguments that suggest gender differences in scientific knowledge and environmental concern. Utilising eight years of Gallup surveys (2001-2008) on climate change and concern conducted in the United States, McCright (2010) revealed three major findings: (i) that women exhibit greater assessed knowledge about climate change than men, (ii) that men report greater perceived understanding of climate change issue than women, and (iii) that women express more concern about climate change than men. According to McCright (2010), "this gender divide is statistically significant and these differences remain consistent over time" (McCright, 2010: 76). McCright (2010) argues that these findings challenge some scientific literacy research that consider women less literate in science including climate change issues, although these findings are consistent with existing sociology of science research that argues that women display less confidence in their scientific knowledge than men do. For instance, a Eurobarometer 2009 study found that while European men reported being better informed about climate change than women, European women consider climate change a very serious problem. Thus, while some studies indicate that men are more knowledgeable and concerned about climate change than women, other studies show that women are more knowledgeable and concerned than men. This inconsistency necessitates more in-depth research.

3.5.1.3 Race and ethnicity

Literature on PUS has not yet established if people's perceptions about climate change are influenced by race and ethnicity. Some studies show that ethnicity is not an important determinant of people's perceptions of environmental risks (Kreger, 1973; Bullard, 1990; Lazo et al., 2000; Slimak & Dietz, 2006). Some studies suggest that African Americans are less concerned about environmental issues than White Americans because they view environmental concern as an elitist notion (Kreger, 1973). Bullard (1990) has shown that there is a growing concern over environmental risks among African Americans, especially those risks to which they are disproportionately exposed. However, a more recent study conducted in the USA by Kalof, Dietz, Guagnano and Stern (2002) found that though blacks were more concerned about mainstream environmental issues than whites, they were much less concerned about global risks including climate change. A few other studies examining the relationship between race and ethnicity and perceptions about climate change indicate that non-whites are more concerned about climate change risks than whites (Malka et al., 2009; Wood & Vedlitz, 2007). These research findings are inconclusive, thus more research on the complex interactions between race and climate change is warranted.

3.5.1.4 Level of education

There is need for more research to establish the relationship between educational levels and concern for climate change. Studies show there is disparate evidence on the relationship between levels of education and perceptions, attitudes and beliefs about climate change. While some studies show that the better educated are more knowledgeable about climate change, others indicate that the less-educated are more concerned about climate change. While some studies found that levels of education correlate positively with a correct understanding and concern about climate change (Eurobarometer, 2011), other studies found a negative correlation with climate change risk perceptions (O'Connor et al., 1999; Malka et al., 2009; Wood & Vedlitz, 2007). In their study conducted in the USA to examine the relationship between risk perceptions and willingness to address climate change, O'Connor and colleagues (1999) found that education is inversely related to concern about climate change risks, with the highly-educated perceiving climate change as less of a risk than the least educated (O'Connor et al., 1999). These findings are consistent with other studies (Kollmuss & Agyeman, 2002; Kellstedt et al., 2008; Malka et al., 2009; Wood & Vedlitz, 2007). There is emerging evidence that a higher level of education does not necessarily translate into increased concern and support for environmental issues (Kollmuss & Agyeman, 2002; Kellstedt et al., 2008). A representative survey study conducted in the USA by Kellstedt et al. (2008) to examine the relationship between public informedness, public confidence in climate scientists, and the role of personal efficacy in affecting climate change outcomes, showed interesting and unexpected results: those who felt they were more informed about climate change showed less concern about the issue and also felt less personally responsible for climate change; and respondents with more confidence in scientists showed less concern and felt less responsible for climate change (Kellstedt et al., 2008). These findings are counter-intuitive, and contrary to the assumptions underlying the knowledge-deficit model of PUS; thus, one would expect that the better 'informedness' an individual reports, the more concerned he or she would become (see Wood & Vedlitz, 2007). This study adds weight to the argument "that the knowledge-deficit model is inadequate for understanding mass attitudes about scientific controversies" (Kellstedt et al., 2008: 122).

Zia and Todd (2010), in their study to establish the relationship between levels of scientific literacy and concern about climate change among Americans living in California's San Francisco Bay Area, found that college education or general science literacy does not increase citizen concern for climate change. Thus, they rejected the hypothesis that "citizens with college education and higher general science literacy tend to have higher concern for global climate change" (Zia & Todd, 2010: 748). Zia and Todd (2010) echo Pardo and Calvo's (2004) recommendation that future studies need to use "more sophisticated questions to assess scientific literacy". On the basis of their research findings in the San Francisco Bay Area study, Zia and Todd postulate that college education will most likely continue to reduce US public concern for climate change (Zia & Todd, 2010: 751). They submit that this counter-intuitive evidence is premised on "the enhanced belief in the capacity of human societies to adapt to change" and that "this explanation will also require further empirical testing" (Zia and Todd, 2010: 751). These research findings and hypotheses are consistent with other studies (Eurobarometer, 2009; Malka et al., 2009; Brewer, 2012) but inconsistent with other studies (for example O'Connor et al., 1999; Wood & Vedlitz, 2007). For instance, Malka et al. (2009) found that the relation between self-reported knowledge and concern about climate change is moderated by trust in scientists and party affiliation. This suggests that while education is important for increased knowledge about climate change, such education may not be sufficient to influence people's concern and support for climate change policies. Thus, there is need for more research to establish the nature of the relationship between levels of education and concern and willingness to address climate change.

Arguably, public education about climate change is necessary for people to obtain accurate information about climate change, yet it is not a sufficient condition for understanding climate change. Indeed, as some studies have shown, promoting educating the public about climate change has not really translated into concern and support for climate change policies especially among the American and British publics (Leiserowitz, 2006; Sterman & Sweeney, 2007; Pugliese & Ray, 2009; Reynolds et al., 2010). Some research has also challenged the so-called "literacy model" (Krosnick et al., 2006).

Some studies have found that educated Americans too misunderstand climate change (Bostrom et al., 1994; Sterman & Sweeney, 2007) and thus indicate that an individual's level of education does not appear to be related to understanding the climate change issue. A study by Bostrom and colleagues (1994), using a set of exploratory studies with well-educated respondents (staff and graduate students, from Carnegie Mellon University, USA) and mental model interviews with 37 members of the general public, found that the lay mental models of climate change were encumbered with basic misconceptions. Although the respondents were very well-educated laypeople, the interviews demonstrated that they still held many misconceptions. The American public appear to conceptualise climate change issues very differently from climate scientists and hold misconceptions about the primary causes, processes, effects, and mitigation and control strategies. A study by Sterman and Sweeney (2007) in which they experimented with highly-educated Americans (graduate students in mathematics and sciences at Massachusetts Institute of Technology (MIT)—in an attempt to understand why most Americans simultaneously believe that climate change is a serious threat but also that policies to reduce greenhouse emissions can be deferred until such a time when ample evidence is gathered that climate change is harmful —found widespread misunderstanding and misconceptions of basic climate change dynamics. The results of the study reveal that even educated Americans seem to have flawed mental models and these shape their understanding of the climate change issue.

Another study conducted in 2009 (Reynolds et al., 2010) to compare 1992 and 2009 survey results of beliefs and attitudes among educated laypeople in the USA about climate change found that despite 17 years of intense media coverage and public education the issue, the public understanding has not significantly changed. They argue that though the 2009 respondents showed a higher awareness and comprehension of some climate change causes compared to the 1992 respondents, most of the 2009 survey respondents still held mistaken beliefs about climate change, and still did not appear to fully appreciate key facts about climate change. For instance, the 2009 survey most respondents did not understand that climate change is mainly caused by increased concentrations of carbon dioxide in the atmosphere, and that the combustion of fossil fuels, notably oil and coal, is the most important source of carbon dioxide. The methodological problem with this comparative study is that the sample of respondents in 1992 was not the same sample used in 2009. As pointed out by the researchers themselves, “there were relatively fewer educated respondents in 2009 as compared to 1992”, and certainly this affected the findings of their study (Reynolds et al., 2010). Nonetheless, the findings from this comparative study are worthwhile as they point to an observation that education alone does not effectively address the public’s misunderstanding (or misconceptions) of the climate change issue. Arguably, improving the public understanding of climate change requires an understanding of people’s mental models about climate change, and then communicating climate change information in ways that are consistent with these mental models (Sterman & Sweeney, 2007; Weber & Stern, 2011).

In their attempt to offer an explanation for this, Weber and Stern (2011) argue that much as the public needs to understand climate change, the problem of public understanding of climate change is not one of “illiteracy”. Basing their argument on their analyses of findings of public opinion polls on the USA public understanding of climate change between 1998 and 2008, Weber and Stern (2011) note that:

> In comparison to the rest of the world, the American public has an average amount of knowledge about climate change and an average understanding of climate change phenomena. U.S. [USA] adults who doubt that climate change is happening, is anthropogenic, or presents serious risks should be assumed not to have a deficit in knowledge but rather to have different understanding (2011: 323).

The point being made above is that public misunderstanding of climate change in America should not be assumed to be a knowledge-deficit issue. In other words, Weber and Stern (2011) are critiquing those who advocate the deficit model of PUS. Weber and Stern note that while the American public may be considered to be relatively well educated, their support for policies to reduce fossil fuel consumption is between 61% and 87% (depending on the policy) but only 50% believe that climate change is anthropogenic. They argue that these statistics signify that Americans’ support for climate change policies is not just a product of their knowledge of climate change but also dependent on several factors. Indeed, educating the public about climate change may not be effective in raising awareness and concern about climate change. People's willingness to change their behaviour as a way of reducing carbon emissions, and consequently combating climate change is not just a product of their cognitive knowledge of climate change issue but may also be influenced by sociological and psychological forces. Researchers should endeavour to uncover these factors.

3.5.1.5 Occupation

There appears to be a correlation between an individual's occupation and perception, beliefs, and attitudes about climate change. Managers, students, other white-collar workers and those who are self-employed feel best informed about the climate change issue while the retired, unemployed and manual workers feel the least informed (Eurobarometer, 2009). On the assumption that the managers, students, white-collar workers and the self-employed would be in possession of some knowledge of causes and consequences of climate change, it was also assumed that they would consider it a very serious problem. On the same assumption, these people are most likely to know and act responsibly to mitigate climate change. In two separate studies (Eurobarometer, 2009, 2011) about Europeans' attitudes towards climate change, it was found that European managers, students, white-collar workers and the self-employed were more aware and concerned about climate change than people who were unemployed, manual workers and retired people, and were also more likely to take action to address climate change (Eurobarometer, 2009, 2011). Other studies, however, show no statistically significant relationship between employment and awareness and concern about climate change (Semenza et al., 2008).

3.5.1.6 Level of income

Level of income is one of the demographic factors that influences a person's awareness, concern about climate change and can predict behavioural intentions to mitigate climate change. Some research findings suggest that the affluent are less concerned about environmental risks, including climate change than the poor (O'Connor et al., 2002; Slimak & Dietz, 2006; Semenza et al., 2008). A study by Semenza and colleagues (2008) conducted in Portland and Houston, USA, found that respondents in both cities earning a lower income (≤ U$30, 000/year) were less likely to be aware of climate change than those with a higher income (>U$30, 000/year). However, the lower earners showed greater concern about climate change than those with a higher income. It is generally postulated that this is the case because comparatively higher earners perceive less risk from the impacts of climate change and have the financial means to respond to the threats (Semenza et al., 2008). A study by Hamilton (2008) indicates that Americans with a higher family income express concern about some of the effects of climate change on polar regions, for example rising sea levels and melting ice caps, but not about the effects of climate change on the biosphere (Hamilton, 2008).

Some studies provide evidence that there appears to be a correlation between concern about local environmental problems and national wealth (Sandvik, 2008). The evidence shows that people from developing countries tend to be more concerned about local environmental problems (including climate change) than those from developed nations. A cross-national study of public concern about climate change by Sandvik (2008) reveals that countries that contribute more to climate change (and these countries have a good measure of national income based on their GDPs) have populations that are most sceptical to the reality of climate change. Thus, accordingly, public concern over global climate change correlates negatively to national measures of wealth and per capita carbon emissions. Sandvik (2008) argues that this finding reveals that geo-economic variables can be used to explain the variation in people’s concern about climate change across the globe. Sandvik observes that the willingness of a nation to contribute to reducing greenhouse gas emissions decreases with its increased share of these emissions. This kind of thinking is greatly influenced by the fear that the richer nations who emit more greenhouse gases expect higher transition costs when policies are designed to reduce anthropogenic greenhouse gas emissions (O’Connor et al., 2002; Zahran et al., 2006, 2007). The desire to avoid incurring these costs may explain the tendency to disregard climate change as a fact or at least as a problem (Norgaard, 2006; Moser & Dilling, 2007). The motivation for such a stance lies in human cognition and psychological disposition to deny “uncomfortable truths” (Sandvik, 2008). Leiserowitz (2006) argues that people devise many ways including outright denial, conspiracy theories, assumptions of hype, or believe in alternative explanations as ways of falsifying “uncomfortable truths.” Indeed, although the citizens of USA, UK and other European countries are considered to be comparatively well-off, better educated and more knowledgeable about climate change, its causes, consequences and ways of mitigating it than their counterparts in developing countries, they are not very willing to support efforts to combat climate change. This begs the questions: How would educated, knowledgeable and affluent citizens in developing countries like Malawi perceive climate change issue? Would they too be reluctant to support efforts (including adjusting lifestyles) to deal with climate change?

3.5.2 Social contextual variables

Perception of environmental risks is greatly influenced by social contextual variables. Social contextual variables identified to have influence on public perceptions about climate change include political identification, local knowledge, religious beliefs and exposure to media. Some have argued that individuals who have a greater affiliation with a climate-concerned social network are also likely to perceive climate change as a more serious threat than those who are not (Zia & Todd, 2010). The sections that follow discuss the influence that political party affiliation, local knowledge, religious beliefs and the media have on public perceptions about climate change.

3.5.2.1 Political ideology and party affiliation

Ideology can have a great influence on people's perceptions, beliefs and attitudes about science in general, and climate change in particular (Wood & Vedlitz, 2007; Zia & Todd, 2010). The concept "ideology" has multiple meanings. However, Carvalho (2007) has aptly defined an ideology as:

> "A system of values, norms and political preferences, linked to a program of action vis-à-vis a given social and political order. People relate to each other and to the world on the basis of value judgements, ideas about how things should be, and preferred forms of governance of the world. In other words, ideologies are axiological, normative and political....the referents of ideologies may include, for example, the economy and the relations between humans and the environment" (2007: 225).

From the above elaboration of what ideologies can do, it is clear that ideologies influence people's understanding and their interpretation and perceptions, beliefs and attitudes to climate change (Carvalho, 2007; Zia & Todd, 2010).

Since the late 1990s, efforts have been made to understand the influence of political ideology and party affiliation on Americans' support for environmental policies (Krosnick et al., 2000; Wood & Vedlitz, 2007; Zia & Todd, 2010; Dunlap & McCright, 2008; McCright & Dunlap, 2011; McCright, 2011; Smith & Leiserowitz, 2012). In the same vein, studies show that there is ideological and political divide about the issue; Democrats/Liberals—who are on *the Left*—believing that climate change is happening and showing more concern about the issue while Republicans/Conservatives—on *the Right*—are sceptical and seem less concerned about climate change (Krosnick et al., 2000; Dunlap & McCright, 2008; Hamilton et al., 2008; McCright, 2009; McCright, 2011; Brewer, 2012). Similarly, studies conducted in Europe also indicate that those who embrace liberal political views believe climate change is occurring, are more concerned about its impacts, and are willing to support climate change policies, while those who are politically more conservative deny the existence of climate change, are less concerned and willing to support climate change policy (Krosnick et al., 1998, 2000; Dunlap & McCright, 2008; Hamilton, 2008; McCright, 2009; McCright & Dunlap, 2011; Eurobarometer, 2009).

A survey study conducted in California's San Francisco Bay Area in 2008 to test the interplay of the effects of ideology (liberal and conservative political ideologies) and other socio-demographic variables on public concern for global climate change found that ideologies more than education significantly influence the American public's understanding of climate change science (Zia & Todd, 2010). This study built on Wood and Vedlitz's (2007) research that found that political ideology and other socio-demographic factors appear to influence the public understanding of climate change. Zia and Todd's first two hypotheses were confirmed: first, "citizens' ideology does have a significant effect on concern for climate change", and second, "college education does not increase climate change concern for conservative ideologies". Their conclusion was "the effect of ideology trumps the effect of college education when it comes to being concerned about global warming" (Zia & Todd, 2010: 751). These findings are consistent with findings from other studies. For instance, Brewer (2012) found that among the most educated Americans differing views on climate change between Democrats and Republicans are greatest (Brewer, 2012).

Dunlap and McCright's two studies (2008, 2011) analysed data from nationally representative Gallup Polls between 1998 and 2008, and between 2001 and 2010, respectively, to evaluate the extent to which the global climate change issue is politically polarised within the American public. For instance, Dunlap and McCright (2008) report that Gallup Poll results on climate change spanning a decade (1998 to 2008) suggest that scepticism among Republican leaders and conservative activists trickled down to those who hold Republican political ideologies. On the one hand, the Republican party leaders, supporters, conservative think tanks, and industrial associations have become sceptical about climate change science and its perceived consequences on human life, while on the other hand, the Democrats, environmental organisations, science advocacy groups, hold beliefs that are consistent with the scientific consensus (like the IPCC Reports, 2007, 2013, 2014) and are willing to support climate change policies (McCright & Dunlap, 2011). The analyses of Gallup Polls conducted between 2001 and 2010 show that liberals and Democrats support climate science and are personally more concerned about climate change than conservatives and Republicans (McCright & Dunlap, 2011). Thus, there is currently a widening gap in USA between Republican and Democrat supporters' perceptions, beliefs and attitudes towards climate change.

Another study by McCright (2009) analysing the social bases of knowledge about climate change, concern, and policy support among the American public (utilising 2001-2008 Gallup Polls) found that political liberals and Democrats tended to express more scientifically accurate beliefs, greater concern, and greater policy support for climate change issues than political conservatives and Republicans. Evidence from this and other studies augment the argument that political ideologies moderate the influence of education and understanding of the climate change issue among the American public, and this poses a great challenge for those seeking public support for climate change policies in USA (Krosnick et al., 2006 Hamilton, 2008; Brewer, 2012). Other scholars, including McCright & Dunlap (2011), are "quite sceptical" that even communicating climate change science through the use of "new media" (that is, blogs and tweets) will improve the public's understanding of the issue.

A study carried out in thirty European countries in 2009 (Eurobarometer, 2009) to gauge people's attitudes towards climate change found similar results; respondents aligning themselves to *the Left* of the political spectrum consider climate change to be a very serious problem and agreed more often than those on *the Right* that the impact of CO_2 emissions are devastating (Eurobarometer, 2009). However, there is need for more research on how political ideology and party affiliation in other countries influence people's perceptions about climate change and their willingness to support public policy.

3.5.2.2 Religious and/or spiritual values

Religious beliefs do have an influence on people's perceptions about climate change (Kempton, 1991; Kempton et al., 1995; Stern et al., 1999; Slimak & Dietz, 2006; Patchen, 2006). Previous research has shown that those that believe in God and that nature is sacred are generally more concerned about ecological and global risks (Kempton et al., 1995; Stern, et al., 1999; Slimak & Dietz, 2006). In their study of environmental values among the American public, Kempton and colleagues (1995) and Stern (1999) found that Americans' support for environmentalism is motivated by the belief that nature is sacred. This means that religious or spiritual beliefs reinforce and justify environmental protection. However, other studies have found results to the contrary, and environmentalism can be driven by other forces, including values and cultural models (Kempton, et al., 1995). For instance, Hayes and Maranguadakis (2000) found that religious beliefs are not a strong predictor of people's environmental behaviour.

Religious beliefs may also be frames of reference used to explain some complex environmental issues. This usually happens when scientific information is not readily available to help in understanding phenomena. A study undertaken by BBC WST (2010) in ten African countries to investigate the public understanding of climate change reveals that one of the important frames of reference that has influence on Africans' understanding of the climate change issue is "the will of God". Africans are generally religious, and some believe changes in weather are "the will of God", meaning that there is God who has allowed the pattern to change and there is nothing man can do to mitigate climate change. Another study by Rudiak-Gould (2012) investigating uptake of climate science among Marshall Islanders found that religious beliefs influence understanding of climate change issue. Specifically, the study found that while some islanders thought that the prediction of nationwide inundation was false because God promised in the book of Genesis never to flood the earth again, others believed that this was true since the book of Revelation predicted climatic chaos. A study by Kellstedt and colleagues (2008) found no statistically significant influence of religion on concern about climate change. The conflicting religious beliefs regarding climate change issue warrants more research. It is important to establish how religious and spiritual beliefs affect people's perceptions about climate change.

3.5.2.3 Environmental beliefs and values

The New Environmental Paradigm (NEP) (the view that nature has intrinsic value and we need to care for it) and the Dominant Social Paradigm (DSP) (the view that nature has utility or extrinsic value) are scales that have been developed to elicit and measure environmental worldviews (Sheppard, 1995). These two opposing paradigms shape people's environmental values and beliefs, and in turn environmental values and beliefs have an influence on how people perceive climate change (Kempton, 1991; O'Connor et al., 1999; Bulkeley, 2000; Pidgeon, 2010). Some studies (e.g., Kempton, 1991; Kempton et al., 1995; O'Connor et al., 1999) have corroborated the link between existing environmental values and people's perceptions about climate change. These studies show that the most widely and strongly held point of reference for environmental values among Americans is the value they ascribe to future generations in general, and to one's descendants in particular. This may explain why the environmental movement is well supported in USA. But this may not be unique to Americans. Another study conducted in USA by O'Connor and colleagues (1999) found that environmental beliefs are strong predictors of behavioural intentions for voluntary actions. The study found that women are more likely to indicate their intent to take voluntary actions to mitigate climate change than men. Policymakers and communicators of climate change should understand that people's value judgements about the environment play a central role in people's support or rejection of climate change policies. Some studies suggest that these environmental beliefs and values are shared across the USA, and this may explain why the majority of Americans support environmentalism (Kempton, 1991, 1995; O'Connor et al., 1999; Slimak & Dietz, 2006).

While some researchers on public understanding of climate science advocate for the deficit model—which assumes that laypeople are ignorant of climate change issues and therefore need more information about climate change—Bulkeley (2000) argues that, on the contrary, understanding people's values, local knowledge and moral responsibilities is enriching to policymakers.

3.5.2.4 Media influences: media exposure and media coverage of climate change issues

People who can easily access newspapers, the Internet, radios, television and other information sources are likely to be more informed about issues than those who have no access the media; perhaps with a caveat, that sometimes the media can misinform the audience. It goes without saying that those who are more exposed to a wide range of media sources are better informed about climate change than those who are not.

Some research findings seem to suggest that public opinion on climate change, certainty, and willingness to act on climate change policies is greatly influenced by the content of media coverage of climate change issues (Fortner et al., 2000; Corbett & Durfee, 2004; Krosnick et al., 2006; Whitmarsh, 2009). It has been noted that while the media has the tendency to use the term "global warming", scientists and policymakers prefer to use the term "climate change" (Corbett & Durfee, 2004). Generally, the mass media is an important source of information about climate change, and therefore has a great influence on public perceptions about climate change (Weingart et al., 2000; Carvalho & Burgess, 2005). Thus, the media's reporting of climate change can influence people's understanding of the issue, and somehow, their willingness to mitigate climate change. In their study to understand the causes of beliefs in global climate change, Krosnick et al. (2006) found that greater exposure to television was associated with an increase in belief in the existence of climate change, while greater exposure to newspapers was associated with less belief in the existence of climate change (Krosnick et al., 2006: 28).

With regards to media reporting of climate change, the accuracy of the information presented and the trust the audience have in the media are two crucial aspects to people's understanding of the climate change issue and their willingness to take action. Research conducted by graduate students at Ohio State University in 1997 in the run-up to the 1997 Kyoto Conference to assess the relationship between media coverage (or presentation) of climate change and public opinion found that people's perceptions and support for climate change is heavily influenced by their trust in media (Fortner et al., 2000). The study, after performing correlation analyses of six variables—education level, media exposure, media trust, media sources, willingness to adopt behaviours, and attitude under uncertainty—found that the respondents' attitude towards climate change "had a statistically significant, positive relationship not only with their trust in media but also their willingness to adopt environmentally responsible behaviours" (Fortner et al., 2000). It should also be pointed out that various sources of the media present the climate change issue differently. For instance, this study found that there was less hedging of scientific information relating to climate change in the print than television. This also had an impact on people's perceptions of climate change and their willingness to take action. This is consistent with other studies (e.g., Spellman, Field & Sinclair, 2003) which found that students who used print media as their main source of information were more likely to understand the science of climate change and related issues than those who used the television (Spellman et al., 2003).

3.5.3 Attitudinal / psychological variables

Since climate change is complex and difficult for lay people to understand, and experts are not readily available to explain the climate change phenomenon, laypeople tend to depend on personal experience to make sense of the climate change issue. It has been argued that risk perceptions are shaped not so much by the characteristics of the risks themselves but by values individuals hold (Slimak & Dietz, 2006). Those that take this line of argument find the value-belief-norm (VBN) theory a plausible explanation for the differences in people's perceptions of ecological risks, including perceptions about global climate change. The VBN theory "postulates that values, and especially concern with the wellbeing of other humans and the biosphere, are at the core of environmental perceptions" (Slimak & Dietz, 2006). Some studies have found these worldviews, beliefs, and values influence perceptions, attitudes and beliefs about climate change and willingness to mitigate climate change (Bord et al., 1998; Kempton, 1991; Kempton et al., 1995; Bostrom et al, 1994; Stoll-Kleemann et al., 2001; Stern, 2000; O'Connor et al., 1999, 2002; Krosnick et al., 2006; Lorenzoni & Pidgeon, 2006; Leiserowitz, 2006; Reynolds et al., 2010; Slovic, 1987; Weber, 1997; Weber & Stern, 2011). Below I discuss some of these attitudinal/psychological factors that influence people's perceptions about climate change.

3.5.3.1 The role of affect, imagery and emotion on climate change risk perceptions

A huge amount of research provides evidence that risk perceptions are a strong determinant of behavioural intentions to mitigate climate change (Weber, 1997; O'Connor et al., 1999; Leiserowitz, 2005; Zahran et al., 2006; Spence et al., 2011). Risk perceptions are influenced by a number of experiential factors. Experiential factors including, affect, imagery and emotion do greatly influence people's risk perceptions about climate change more than scientific evidence (Slovic, 1987; Weber, 1997; Leiserowitz, 2005, 2006). There appears to be a positive relationship between the belief that climate change is real and therefore a serious threat to human life, and people's behavioural intentions i.e., willingness to take action against climate change (O'Connor et al., 1999). In other words, people who perceive climate change to be real and pose a risk to humanity are more likely to take action to mitigate climate change than those who think otherwise. This entails that "psychological distance of climate change" has an influence on people's concern and willingness to take action (Spence et al., 2011). Some theorised dimensions of the psychological distance of climate change include: temporal, social, and geographical distance, and certainty/uncertainty. Thus, lower psychological distance is generally associated with higher levels of concern while a larger psychological distance is associated with lower levels of concern (Spence et al., 2011).

Generally, studies on risk perceptions about climate change conducted in the UK and USA indicate that the publics in both countries perceive climate change impacts as a moderate threat, and one that only affects geographically distant people or nations and future generations, hence their unwillingness to take action (Bord et al., 1998; Norton & Leaman, 2004; Leiserowitz, 2005; Lorenzoni et al., 2006; Lorenzoni & Pidgeon, 2006). A national survey study conducted in the USA to examine risk perceptions and connotative meanings of climate change found that Americans generally perceived climate change as a moderate risk (Leiserowitz, 2005). The study also found that Americans think that the impact of climate change will affect geographically and temporally distant people and places more than themselves (Leiserowitz, 2005). This is consistent with other studies (see O'Connor et al., 1999; Slimak & Dietz, 2006). This probably explains why Americans strongly support some national and international policies to address the climate change issue, and strongly oppose other proposals, including those to increase taxes and prices on fossil fuel-based energy and gasoline (Leiserowitz, 2006).

Affective image associations with climate change play an important role in public perceptions of climate change. Slovic, MacGregor and Peters (1998) list affective images as including "insights, sounds, smells, ideas and words, to which positive and negative affect or feeling states have become attached through learning and experience" (Slovic et al., 1998: 3). Thus affective images of climate change can be construed to generate good/positive or bad/negative feelings associated with the climate change phenomenon (Leiserowitz, 2005, 2006). Leiserowitz's (2006) representative survey study in the USA found that the term "global warming" evoked negative connotations for all the 673 respondents. In addition, the study found that alarmist images of disaster produced the strongest negative affect and climate change sceptics (naysayers) exhibited very low negative affect (Leiserowitz, 2006). A study by Smith and Leiserowitz (2012) exploring how affective image associations to climate change changed in the USA between 2002 and 2010 found that there is a steady increase in the number of Americans who are sceptical about climate change. Furthermore, the study found that holistic affect and "naysayer" imagery were more significant determinants of climate change risk perceptions than political party and ideology, cultural worldviews, and socio-demographic variables. It was also noted that the alarmist imagery was rated more negatively, suggesting that the American public are beginning to doubt the likelihood of catastrophic climate change (see O'Neill & Nicholson-Cole, 2009; Lowe, Brown, Dessai, de Franca Doria, Haynes & Vincent, 2006). These research findings suggest the important roles affect and imagery play in climate change perceptions and beliefs, and policy support among the American public, and also challenge studies that suggest that apocalyptic narratives of climate change do promote public support for climate change policies (see Spoel, Goforth, Cheu & Pearson, 2009).

Some in-depth studies and surveys to understand risk perceptions relating to climate change suggest that people believe that climate change will have more impact on society than on their personal lives (Spence & Pidgeon, 2010). A nationally representative study conducted in the UK by Spence and colleagues (2011) examined the relationship between the aspects of psychological distance, people's concern and willingness to take action against climate change found that the British public perceive climate change risks as both distant and proximal. Specifically, the study revealed four things: firstly, the British public did not find climate change to be a predominantly geographically distant phenomenon; secondly, they believed that climate change would disproportionally impact developing countries; and thirdly, climate change effects are being felt by the British, suggesting that climate change is temporally close to them. Lastly, the majority also believe it is anthropogenic with 18% believing that it is has natural causes. This comprehensive and in-depth study indicates how the way the British public perceives each aspect of psychological distance of climate change has a bearing on their support of policy and willingness to take action to mitigate climate change. It is on the basis of this understanding that some argue that portraying climate change as very risky and catastrophic does help to garner public support for climate change policy. However, other studies show that fearful representations of climate change do not promote public engagement with the issue (Lorenzoni et al., 2007; O'Neill and Nicholson-Cole, 2009; Weber, 2010; Smith & Leiserowitz, 2012). Now that we know more about risk perceptions of climate change in the UK and USA, the big questions remain: How would Africans in general, and Malawians in particular perceive climate change in the face of the climate change effects they are already experiencing? Would they be unconcerned about climate change?

Studies have found that climate change is not considered a very serious threat when ranked with other socioeconomic and environmental problems (e.g., Bord et al., 1998; 2000; Shisanya & Kayesi, 2007). Shisanya and Kayesi (2007) conducted a survey of 132 residents in Nairobi, Kenya, to examine people's perception of climate change in relation to 21 other socioeconomic and environmental issues, and found that the concern about climate change appeared as a 'drop in the ocean' compared with other issues like poverty, unemployment, crime and corruption. However, in Europe, another study (Eurobarometer, 2009) found that there the issue of climate change was ranked the third most important problem, and the 2011 Eurobarometer shows that climate change is ranked even higher as the second serious problem facing the world today after poverty, hunger, and lack of drinking water (all these put together). Analyses of these studies suggest that climate change is somewhat perceived as a salient issue i.e., an issue that directly threatens people's wellbeing and livelihood. Weber

(1997, 2010) and Weber and Stern (2011) have consistently argued that both affect-based and analysis-based decisions to deal with climate change are unlikely to motivate significant public action because climate change is inherently a difficult phenomenon to be detected and tracked based on personal experience and uncertainties over future climate change impacts. Weber (2010) posits that "rule-based decisions that determine behaviour based on moral or social responsibility may hold out the best prospects for sustainable action (Weber, 2010: 331). Thus, Weber (2010) echoes Bulkeley's (2000) recommendations to climate change policymakers.

3.5.3.2 Frames of reference (mental or cultural models)

Admittedly, climate change is a complex phenomenon that is difficult to understand based on personal experience. Climate science eludes the cognitive abilities of the majority of lay people (Bord et al., 2000; Weber & Stern, 2011). It should therefore not be surprising that, generally, there is a mismatch between the lay public's understanding of climate change and the understanding of scientists. To understand this inherently complex phenomenon lay people resort to using local knowledge, and thus people's perceptions of climate change may also be shaped by their existing knowledge of the issue (Kempton, 1991, 1997). In other words, new information about climate is interpreted and framed by other (local) knowledge of the issue and forms part of lay people's mental and cultural models.

The 'frames of reference' are developed by lay people to help them comprehend complex phenomena. Suffice it to say that mental models can either block or enhance communication of information about climate change to the public. Studies conducted in the USA and some African countries have found that in the absence of a solid scientific understanding of climate change the lay public draw upon their existing beliefs, knowledge, and values to construct images and explain climate change (Kempton, 1991; Bostrom et al., 1994; Reynolds et al., 2010). According to Reynolds and colleagues (2010) "mental models are internal representations of external realities". Mental models—which are the engines of inference—are, more often than not, in conflict with new information, and Reynolds and colleagues (2010) argue that people usually process new information in light of their existing beliefs of "how the world works" (Reynolds et al., 2010). Weber and Stern (2011) note that scientists and laypeople develop their understandings differently, hence the differences in their understanding of the climate change issue. Elaborating on this point, Weber and Stern (2011) argue that while science experts on the one hand, use systematic methods such as observations and experiments, systematic observation and measurement, mathematical models, and scientific debate and deliberation to gather evidence and explain climate change, lay people, on the other hand, use personal experience, values, mental models, and judgement, (Weber & Stern, 2011).

Mental models influence people's understanding of climate change (Kempton, 1991; Kempton et al., 1995). A study by Kempton (1991) using fourteen ethnographic interviews with a small but diverse sample of USA residents living in Hamilton Township, New Jersey, aimed to understand how ordinary citizens conceptualise climate change and make value judgements about it. Unlike the survey research methods in which the questions and range of possible answers are made known to respondents and precise answer frequencies are measured, ethnographic interviewing methods use open-ended questions, follow-up probes for topics raised by informants, and paraphrases for verification. The results of this study reveal that lay people conceptualise climate change very differently from scientists because they interpret it in terms of four existing categories related to stratospheric ozone depletion, tropospheric air pollution, plant photosynthesis and respiration, and weather variation. Kempton (1991, 1997) calls these 'mental/cultural models'. These cultural/mental models, albeit wrong ones, are used by the USA public to understand and explain climate change. A qualitative study dubbed *Africa Talks Climate* (2010) by BBC WST—carried out in ten African countries, namely, Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Nigeria, Senegal, South Africa, Sudan, Tanzania and Uganda—found a near-universal sense across all the people interviewed that 'weather' is changing and these changes are already affecting their lives. The respondents, however, could not identify the correct causes of these changes, let alone articulate the science of climate change. The respondents ended up conflating the terms 'climate' and 'weather'. The study revealed that Africans have frames of reference in their conception of climate change which are quite different from those scientists have. These frames of reference include emphasis on trees, the will of God, air pollution, depletion of ozone layer, and localised heat. For instance, many Africans think that deforestation reduces local rainfall and increases the occurrence of drought, and that the destruction of the ozone is a primary cause of climate change. These beliefs are shaped by the people's frames of reference about climate change.

Educated people also use wrong models to understand climate change issue. Sterman and Sweeney (2006) and other studies note that most Americans believe climate change is a serious threat to human life and biodiversity, but at the same time, they also strongly hold the view that personal initiatives and national policies to reduce the emissions of greenhouse gases can be deferred until there is ample evidence that climate change is harmful (Sterman & Sweeney, 2006). This is a contradiction. Sterman and Sweeney (2006) reporting on experiments they conducted with graduate students at MIT to explain this apparent contradiction of beliefs, hypothesised that "low public support for mitigation policies may arise from misconceptions of climate dynamics rather than high discount rates or uncertainty about the impact of climate change". However, their experiments show that even educated people have flawed mental models about climate change. They point out that educating the public would be unlikely to make people support climate change policies since people's perceptions about climate change are influenced not only by their education but also by a plethora of contextual factors, including social background, religious beliefs, and political orientation (Sterman & Sweeney, 2006; also see O'Connor et al., 2002).

People's mental and/or cultural models do influence the public's understanding of climate change, and inadvertently their support for climate change policies. Some theorists argue that that a correct understanding of the causes and consequences of climate change is the key to people's willingness to voluntarily act in ways to mitigate climate change. A survey of 1, 225 adults carried out in the USA in 1997 by O'Connor and colleagues (1999) to examine the relationship between risk perceptions and willingness to address climate change found that knowledge about the causes of climate change is the most powerful predictor of people's behavioural intentions to combat climate change (O'Connor et al., 1999; Bord et al., 2000). In other words, knowing what causes climate change is the key determinant of both stated intentions to take voluntary actions and to support government policies to reduce greenhouse gas emissions. Bord and colleagues (2000) argue that translating public concern for climate change into effective action requires accurate knowledge about the issue.

3.5.3.3 Uncertainty and scepticism about climate change issue

Despite extensive media coverage and educational campaigns on the climate change issue, some members of the public, particularly in the USA and Europe, are still uncertain and sceptical about the causes and consequences of climate change. Some sections of the public do not believe that climate change is largely anthropogenic, and this scepticism makes them less likely to behave sustainably (Spence et al., 2011). Studies indicate that there are different perspectives with regard to climate change (Brechin & Bhandari, 2011; Spence et al., 2011). Lorenzoni and Langford (2001), after examining perceptions, attitudes and behaviour to climate change in Norwich, UK, identified four "typologies". These are: "Denying" (the view that climate change is not anthropogenic and that climate change is not important); "Doubting" (the view that climate change is not anthropogenic but nonetheless climate change is important); "Uninterested" (the view that climate change is not anthropogenic and that climate change is not important); and "Engaging" (the view that climate change is anthropogenic and that climate change is important). Another important finding of this study is that many of the respondents who thought that climate change is anthropogenic and important "had already adopted or were willing to adopt lifestyle changes" (Lorenzoni & Langford, 2001: 20). Thus each of these four perspectives has implications on people's willingness and support for policies to combat climate change, with sceptics showing less concern and being unwilling to take action. The big question is: Can those who experience the impacts of climate change, especially citizens of developing countries, doubt or deny that climate change is important?

Generally, people prefer certainty over uncertainty about the climate change issue (Spence et al., 2011). Some studies suggest that some members of the public use uncertainty as justification for not taking action (Lorenzoni et al., 2007; Semenza et al., 2008). Lorenzoni and colleagues (2007) argue that uncertainty about climate change emanates from a lack of knowledge about the causes, impacts and solutions to global climate change. Bord and colleagues (2000), who conducted their study in the USA, found that a correct understanding of the causes of climate change is the most powerful determinant of behavioural intentions and willingness to address global climate change (Bord et al., 2000: 205). However, they also note that other factors, such as general environmental beliefs and perceptions that climate change is a serious threat to society, do also influence people's willingness to take voluntary action (Bord et al., 2000). While some studies (e.g., Bord et al., 1998) were not able to articulate the relationship between knowledge and support for climate change policies, Krosnick and colleagues (2006) postulate that factual knowledge increases certainty, which in turn increases concern about climate change, which in turn increases support for climate change policies (Krosnick et al., 2006: 36). Thus, certainty, concern and support for climate change policies come with accurate knowledge of the issue. Nonetheless, Krosnick and colleagues (2006) are cautious to point out that this is not to suggest that all an individual needs to support climate change policies is knowledge about climate change. In fact, the realisation that climate change is a challenging global issue with no easy solution may overwhelm some people who may then ignore it (Downs, 1972, cited in Krosnick et al., 2006;

Semenza et al., 2008). This means that certainty about the climate change issue can work either for or against support for policy.

How certainty and knowledge about climate change affect concern and support for public policy is beyond the scope of this discussion. However, it is clear that certainty and knowledge about climate change can sometimes work against concern and support for climate change mitigation.

3.5.4 Geophysical variables

A huge amount of research on public perceptions about global climate change has shown that people's perceptions are influenced by demographic, attitudinal and social contextual variables (Bord et al., 1998; Kempton, 1991; O'Connor et al., 1999; Bord et al., 2000; Spellman et al., 2003; Leiserowitz, 2006; Slimak & Dietz, 2006; McCright, 2010; Reynolds et al., 2010; Zia & Todd, 2010; Spence et al., 2011; Smith & Leiserowitz, 2012). However, few researchers have endeavoured to investigate the effect of local geographic and physical variables, especially local weather and physical vulnerability, on public perceptions of climate change (Zahran et al., 2006; Brody et al., 2008; Li, Johnson & Zaval, 2011; Egan & Mullin, 2012). In this section I discuss the influence local geographic and physical variables have on perceptions about climate change.

3.5.4.1 Local temperature variations

Local weather variations can influence people's perceptions about climate change. Climate consists of a number of features including temperature, precipitation, wind, cloud cover, and humidity. Climate is an abstract phenomenon, and climate change is therefore a difficult and complex phenomenon for many people to understand. When people are asked about climate change, most people make sense of the phenomenon by associating it with daily weather patterns, especially temperature and precipitation patterns. This process whereby "the target attribute is relatively inaccessible; and…a semantically and associatively related candidate attribute is highly accessible" is what is referred to as attribute substitution (Kahneman & Frederick, 2002: 54; cited in Li et al., 2011). Thus, in most cases temperature and precipitation are best conceptualised as "climate". For instance, a qualitative study conducted in ten African countries in 2010 found that Africans generally associate climate with weather (BBC World Service Trust, 2010).

Lorenzoni and colleagues (2006) found that there were stark similarities and differences in the images the USA and UK respondents used in explaining climate change. One of the similarities was that both USA and UK respondents associate climate change with increases in temperature, ozone layer depletion, and adverse outcomes ("disasters"). Thus, in both countries climate change evokes negative connotations. The major cultural difference between the UK and USA respondents is that while the UK respondents associated climate change with "rain", the USA public associate climate change with "hot weather". One observes that both in the UK and USA there is a stronger association of climate change with respective local weather, signifying how climate change is usually identified with local weather patterns (Berk & Schulman, 1995; Lorenzoni et al., 2006), which is consistent with other research findings (Kempton, 1991; BBC WST, 2010). It is worth noting that the terminology used to describe global climate change does, to some extent, influence people's psychology. For instance, while most Americans use the term "global warming", the British public and general media often use the term "climate change". This terminology also influences people's beliefs and understanding of climate change. For example, a study by Whitmarsh (2009) conducted in Portsmouth, a city in the south of England, to examine how terminology is understood by the public, found that the term "global warming" seemed to evoke more concern than the term "climate change" as "it suggests a clear direction of change towards increasing temperatures; while the implications of "climate change" are more ambiguous" (Whitmarsh, 2009: 416).

Few studies have been conducted to examine the relationship between personal experience of local temperature variation and the belief that climate change is taking place (Krosnick et al., 2006; Zahran et al., 2006; Lorenzoni & Pidgeon, 2006; Li et al., 2011; Egan & Mullin, 2012). A representative survey study conducted in the USA by Krosnick and colleagues (2006) found that perceived changes in the weather had an influence on the belief that climate change is taking place; "people who thought that their local temperatures had increased recently were significantly more likely to believe in climate change's existence, regardless of media trust or education" (Krosnick et al., 2006: 29). A study by Lorenzoni and Pidgeon (2006) to examine how climate change is conceptualised by the publics in Europe and in the USA found that there is a positive correlation between concern about climate change and average temperature in July across fifteen European countries. In their unrepresentative survey study conducted in United States and Australia, Li and colleagues (2011) found that respondents' belief that climate change is occurring and their concern about it depended on their experience of the local temperature on the day of study; if it felt warmer or colder than normal, those who were greatly concerned about climate change would give higher donations towards a climate-change charity. Egan and Mullin (2012)—in their representative study carried out in the USA—found similar results, suggesting that experience of local weather patterns somehow influences people's beliefs about the occurrence of climate change and subsequently, their willingness to support climate change public policies. Indeed, some people believe that extremely cold conditions mean that the climate is not changing, while extreme hot weather conditions mean that climate change is happening (Weber & Stern, 2011). Of course, these beliefs are not supported by climate science since climate change impacts are quite complex. Nonetheless, these beliefs cannot be ignored as irrelevant as they influence people's willingness to mitigate climate change.

3.5.4.2 Physical vulnerability

The influence of the physical environment on people's perceptions of climate change and willingness to support government efforts to mitigate climate change is one area that has received little attention by researchers on public understanding of climate change (Zahran et al., 2006). A study by Berk and Schulman (1995) found that the American public appreciates some features of climate more than others. Their respondents were more willing to climate change prevention if they perceived the imaginary climate scenarios to be more serious (i.e., dramatic changes in temperature and precipitation).

Two studies (Zahran et al., 2006; Brody et al., 2008) in the USA attempted to shed light on the influence physical factors (and particularly physical vulnerability) have on public perceptions about climate change and willingness to support climate change policies. These studies show that people's physical vulnerability to climate change is a determining factor in explaining their perceptions about climate change and willingness to support climate change policies. Thus, physical conditions and experiences do matter in perceptions of climate change risks and support for climate change policies (Zahran et al., 2006; Brody et al., 2008). This implies that catastrophic events like tsunami, volcanic eruptions, and floods may also be perceived by some people as evidence of changing climate.

3.6 Factors that influence public perceptions, attitudes and beliefs about climate change: A summary

To sum up, studies on the public understanding of climate change show that public perceptions, beliefs and attitudes to climate change are influenced by socio-demographic, social contextual, attitudinal and geophysical factors. Figure 3.1 below is a model that attempts to explain the research findings on the influence various variables have on public perceptions, beliefs, and attitudes towards climate change. The model merely depicts how the review on research findings on public perceptions about climate change is organised. The figure shows that a person's willingness to take action (either voluntarily or supporting public policy) is directly affected by knowledge, awareness, certainty or scepticism, risk perceptions and concern about climate change. These variables are, in turn, influenced by a plethora of factors grouped into four categories: socio-demographic, social contextual, geophysical and attitudinal variables, which also interact with each other. These four categories should be construed as independent variables.

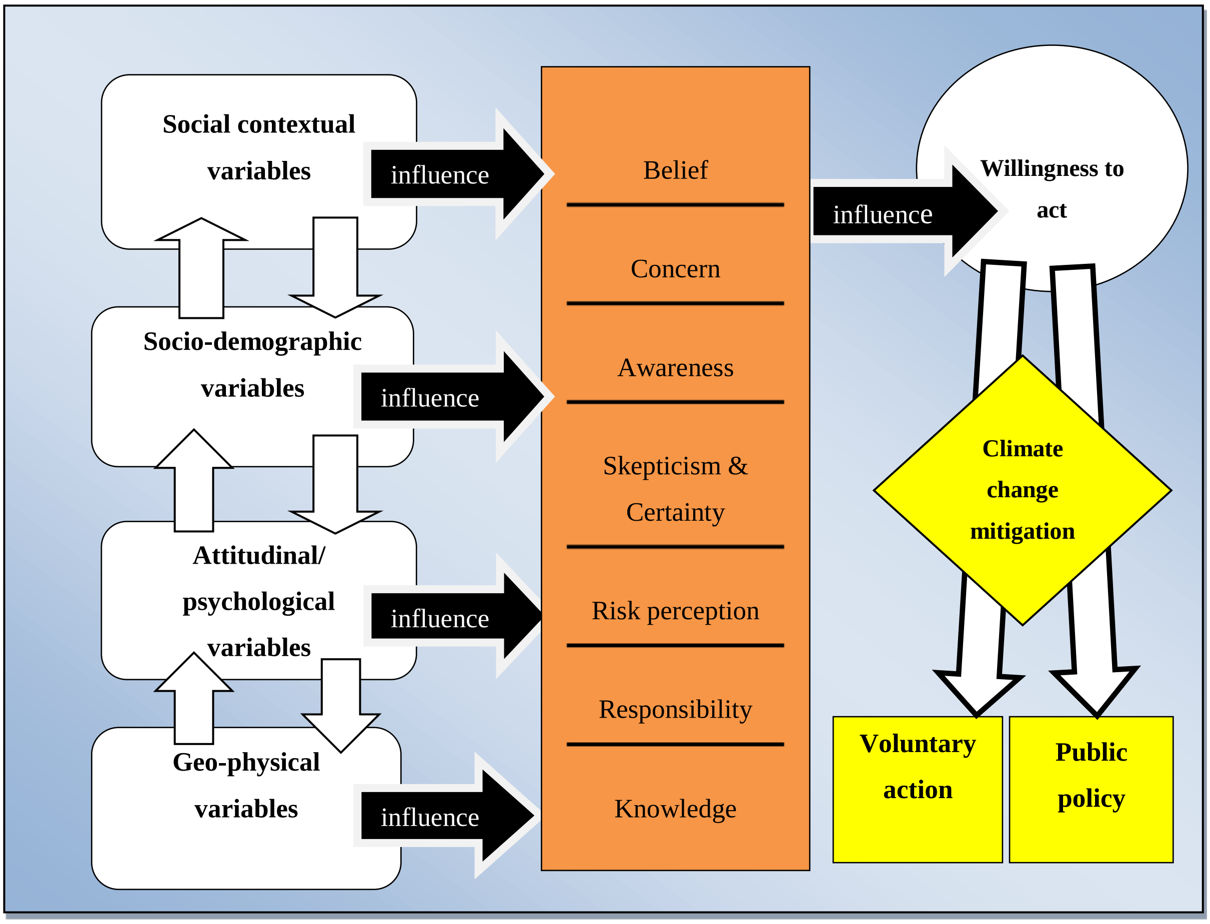

Figure 3.1: A theoretical model illustrating factors that influence perceptions, beliefs and attitudes towards climate change

3.7 Climate change issue in Malawi

Malawi's economy is dependent on rain-fed agriculture, and it is among the countries that are at risk from the various effects of climate change. Studies show that most developing countries including Malawi are especially vulnerable to climate change (Maddison, 2006; Saka et al., 2013; Simelton et al., 2013). However, researchers have paid little attention to how citizens from these developing countries perceive climate change. Only a handful of polls and studies have been conducted to gauge people's understanding of climate change at a more general level. This is one study that attempts to understand the factors that influence people's perceptions, beliefs, and attitudes to climate change in the developing country of Malawi. Most importantly, it is the first study of this kind to be conducted in Malawi.

An analysis of research on the climate change issue in Malawi reveals three important things. Firstly, serious discussion on the climate change issue has gained currency since the early 2000s. During this period the Government of Malawi, through the Ministry of Mines, Natural Resources and Environment, developed three policy documents: The *Initial National Communication under the United Nations Framework Convention on Climate Change* in 2002; the *National Environmental Policy* (NEP) in 2004; and the *National Adaptation Programmes for Action* (NAPA) in 2006. These policy documents became a catalyst for more interest in climate change at national level. Secondly, the discourse on climate change has mostly been dominated by natural scientists. The natural scientists have focussed on evaluating the extent of climate variability and projecting future impacts of climate change on Malawi's ecological system and agricultural production (Ngongondo, 2005; Saka, Sibale, Thomas, Hachigonta & Majele Sibanda, 2013). The agricultural scientists are preoccupied with investigating how people, particularly farmers, are coping with and adapting to climate variability (Bie, Mkwambisi & Gomani, 2008; Stringer, Dyer, Reed, Dougill, Twyman & Mkwambisi, 2009; Kakota et al., 2011). Thirdly, a few social scientists, especially economists and social geographers, who have conducted research on climate change issue in Malawi, have been interested in assessing the impact of climate change on people's livelihoods and the economy (Clay, Bohn, Blanco de Armas, Kabambe & Tchale, 2003; ActionAid International, 2006; Fisher, Chaudhury & Mccusker, 2010; Chipeta, 2010). Some social researchers have investigated farmers' experiences and perceptions about rainfall variability and change (Kalanda-Joshua, Ngongondo, Chipeta, & Mpembeka, 2011; Simelton, Quinn, Batisani, Dougill, Dyer, Fraser, Mkwambisi, Sallu, & Stringer, 2013). While there is some research that has investigated farmers' perceptions about rainfall variability and change, it is clear that researchers have not engaged with the general Malawian public to investigate their understanding of climate change, let alone the factors that influence their perceptions, beliefs and attitudes towards climate change. Thus, lay people's involvement and/or participation in climate change discourse in Malawi remain on the periphery.

Having noted the that there is no research investigating factors that influence Malawians' perceptions, beliefs and attitudes about climate change, this study is an attempt to fill this gap. In this study I hypothesise that the Malawian public's perceptions, beliefs and attitudes to climate change is greatly influenced by the negative impact of climate change on their livelihoods (i.e., subsistence agriculture and related agro-based economic activities, as 85% of the population depend on rain-fed agriculture). In other words, my presupposition is that the impact of climate change, particularly rainfall variability, on agricultural production in Malawi is a key determinant of perceptions, beliefs and attitudes towards climate change and people's willingness to support climate change policies.

3.8 Conclusion

Though climate change is arguably the most daunting challenge facing humanity in the twenty-first century, it seems that the majority of the lay public does not really understand the science of climate change. This is despite serious campaigns undertaken to educate the public about the climate change issue. Studies assessing the public's uptake of climate change information show that efforts to educate the public on the issue have met with little success. Most of these studies have employed quantitative survey methodology to assess how much the public know about climate change and related issues. The underlying assumption of these studies is that the general public are ignorant of climate change issue, and they therefore need more accurate information to enhance their understanding. However, some scholars argue that public misunderstanding of climate change is not a result of a deficit in knowledge about climate change; rather there are some psychological, sociological and geophysical factors that shape people's understanding of climate change. It is generally accepted that public perceptions, beliefs and attitudes towards climate change have a bearing on public support or opposition to climate change policies. Thus, understanding these factors is an important step not only in communicating the climate change message to the public, but also in the formulation and implementation of effective climate change policies. Surprisingly, there is has not been much research done on this in the Sub-Saharan African region.

Hitherto research on public understanding of climate change shows that perceptions, attitudes, and beliefs about climate change are influenced by a number of factors including demographic, attitudinal, social contextual and geophysical factors. Most of these studies have been conducted in the United States and Europe. However, not much attention has been paid to the relationship between the socioeconomic impacts of climate change and perceptions, beliefs, and attitudes towards climate change, especially in the most vulnerable developing countries. Thus, research to better understand this relationship is warranted and this study is an attempt to fill this important gap in the literature on public understanding of climate change. It will investigate factors that influence Malawians' attitudes, perceptions and beliefs about climate change, and in particular whether the impact of climate change on people's livelihoods is a key determinant of their perceptions, attitudes, and beliefs about climate change and their willingness to support climate change policies.

CHAPTER 4

RESEARCH DESIGN, METHODOLOGY AND METHODS

4.1 Introduction

This chapter provides an overview of the conceptualisation of the study: the research questions, hypotheses, independent variable(s) and dependent variables. The chapter also describes the design, methodology and methods that were used to analyse data for the purposes of answering the research questions. On the basis of the conclusions drawn from the review of literature in Chapters Two and Three, I argue that a mixed-methods research approach is the most appropriate method for investigating the factors that influence Malawians' perceptions, attitudes and beliefs about climate change.

This chapter is organised as follows: Section 4.2 gives an overview of the conceptualisation of the study (i.e., research questions, hypotheses, independent variable(s) and dependent variables). Section 4.3 discusses the rationale for employing a mixed-methodology approach in the study. Section 4.4 discusses in detail design of the data collection instrument and pre-testing. Section 4.5 discusses the recruitment and training of interviewers. Section 4.6 discusses the sample design and sampling methods. Section 4.7 discusses fieldwork practice and challenges encountered during the data collection exercise. Section 4.8 sums up the debriefing session with interviewers. Section 4.9 discusses how quantitative and qualitative data were reduced and analysed. Section 4.10 discusses the limitations of the data collection instrument. Section 4.11 gives an overview of the response rate as well as the spatial distribution and demographic profile of the study participants. Section 4.12 focusses on reliability, validity, credibility and trustworthiness of the data. Last but not least, Section 4.13 covers the scope, sources of error, limitations and delimitations of the study.

4.2 Conceptualisation: Research Questions, Hypotheses, Independent variable(s) and Dependent variables

The theoretical assumption guiding the study is that both the deficit and constructivist models are relevant and useful to investigating and understanding factors that influence Malawians' perceptions, beliefs, and attitudes towards climate change. Arguably, the two models are not in competition and incompatible, but rather two sides of the same coin. I argue that the deficit model and the constructivist model complement each other if we are to fully understand how the Malawian public understand climate change.

This study addresses the following main research question: What factors influence perceptions, beliefs and attitudes towards global climate change in Malawi? The sub-questions include: (i) What does the public in Malawi know and understand about climate change? (ii) What perceptions, beliefs and attitudes do people have about global climate change? (iii) Does the impact of climate change on the livelihood of rural Malawians influence their perceptions, beliefs and attitudes towards climate change? (iv) What factors predict perceptions, beliefs and attitudes towards climate change in Malawi? (v) Does the impact of climate change on an individual's livelihood predict beliefs, perceptions and attitudes towards climate change?

The importance of having research questions cannot be over emphasised. As Plano Clark and Badiee (2010: 277) argue, "research questions set the boundaries of a research project, clarify its directions, and keep a study from becoming too large". Indeed, the success of any research project is determined by how convincingly others feel the research questions have been answered.

Considering that at least 85% of the population of Malawi live in rural areas and depend on subsistence rain-fed agriculture for their livelihood and are therefore more vulnerable to climate change effects, I hypothesised that their perceptions, beliefs and attitudes towards climate change would be influenced by demographic and social contextual factors, including the impact of climate change on their livelihoods. Thus, more rural than urban inhabitants were likely to agree that their livelihoods have been negatively affected by climate change. In addition, significantly more rural inhabitants (who are more vulnerable to climate change effects) were likely to take voluntary action to address climate change than their urban counterparts.

Independent variables included location, highest level of education, highest level of education in science-related subject, gender, religious affiliation, monthly household income, age, number of household members, political beliefs, source of information, and ethnicity. The main dependent variables in the study were the perceptions, beliefs and attitudes about climate change. In this study the sample population included all Malawian adults (i.e., those aged 18 and older) who are heads of households.

4.3 Rationale for employing Mixed-Methods Research

This was a mixed-methods study[15], meaning that both qualitative and quantitative research approaches were used to collect, analyse and interpret the data findings. Since the 1980s there has been a protracted and heated debate on whether qualitative and quantitative approaches are compatible. While some scholars, including Lincoln and Guba (1985) and Smith and Heshusius (1986), insisted that qualitative and quantitative methodologies are incompatible, others including Howe (1988) and Tashakkori & Teddlie (1998) have attempted to reconcile the two opposing camps. During the 1980s and early 1990s some social and behavioural scientists argued that the qualitative and quantitative research approaches are compatible (Tashakkori & Teddlie, 1998). Recognising that there are strengths and weaknesses in both approaches, some scholars developed an approach that combines the two, thereby allowing "the strengths to be capitalized upon and the weaknesses to be offset somewhat" (Bryman, 2008: 603). This approach of combining elements of both qualitative and quantitative approaches has become known as "mixed-methods research". Today, research that combines qualitative and quantitative elements has gained acceptance, legitimacy, and credibility among scholars. It is worthwhile pointing out that mixing methods can be done in one or more phases of the research process, including the research design, data collection, data analysis and interpretation and contextualisation of findings (Brannen, 2005; Creswell, 2009).

While there is now a trend of doing research that combines qualitative and quantitative approaches (Bryman, 2008), few researchers who use a mixed-methods approach do so without providing clear justification. The choice for using both qualitative and quantitative research methodologies should be justified by researchers, as there is an assumption that research that uses mixed methods is inherently unbiased (since it potentially neutralises or cancels biases inherent in both qualitative and quantitative methodologies). However, this should not be assumed and justification for this choice in this particular study is made in the following paragraphs.

[15]Mixed methods research is a fairly a new approach to doing social research. It is defined by John W. Creswell as "research in which the inquirer or investigator collects and analyses data, integrates the findings, and draws inferences using both qualitative and quantitative approaches or methods in a single study or a programme of study" (Creswell & Plano Clark, 2007; see also Bryman, 2008; Bergman, 2008; Creswell, 2009). Numerous terms/names are used for the mixed methods approach, including *multi-method*, *convergence*, *blended*, *merged*, *integrated*, or *combined* (Creswell & Plano Clark, 2007; Bryman, 2008).

The choice of a mixed-methods design is dependent on four important aspects (Creswell, 2003; Creswell & Plano Clark, 2007; Creswell, 2009; Terrell, 2012). These are timing (whether data are collected concurrently or sequentially), weighting (whether priority is given to quantitative or qualitative research, or both equally), mixing (the point at which the data are mixed), and theorising (whether the theoretical perspective that guides the entire design is made explicit or is implicit). Depending on the choices made for these four aspects, Terrell (2012) observes that the mixed-methods approach does provide a researcher with a wide variety of designs involving a range of sequential and concurrent strategies. For example, two concurrent mixed-methods designs (triangulation and embedded designs) and three sequential mixed-methods designs (explanatory, exploratory, and embedded designs). This study used a concurrent embedded mixed-methods design.

4.3.1 Concurrent embedded design

The concurrent embedded (i.e., nested) design is also referred to as a multilevel design by Tashakkori and Teddlie (1998). In his conceptualisation of a concurrent embedded design, Creswell (2009) writes:

> "A concurrent embedded mixed-methods design has a primary method that guides the project and a secondary database that provides a supporting role in the procedures. Given less priority, the secondary method is embedded, or nested, within the predominant method. This embedding may mean that the secondary method addresses a different question than the primary method or seeks information at a different level of analysis" (Creswell, 2009: 214).

As described by Creswell (2009) above, the concurrent embedded design in this study used one data collection phase during which both qualitative and quantitative data were collected simultaneously. Both quantitative and qualitative data were mixed during the analysis phase. As articulated by Creswell and Plano Clark (2007) and Creswell (2009), the primary purpose for employing this design in the study was to gain a broader perspective, which would not be the case if only quantitative data had been used; and the secondary purpose was the use of qualitative data to address some of the study's research questions.

The justification for using a concurrent embedded design in this study was three-fold (see Creswell, 2009). Firstly, this model enabled the researcher to collect qualitative and quantitative data simultaneously during a single data collection phase, thereby saving time and money. Secondly, the concurrent embedded model provided the study with the advantages of both qualitative and quantitative data. Thirdly, by using quantitative and qualitative methodologies in a single study, a wider perspective on the public understanding of climate change in Malawi could be obtained. See Figure 4.1 outlining a concurrent embedded mixed-methods design.

Figure 4.1 below is a methodological framework for the study, outlining a concurrent embedded mixed-methods design. It is adapted from Creswell et al. (2003), with the addition of two stages: conceptualisation and the literature review.

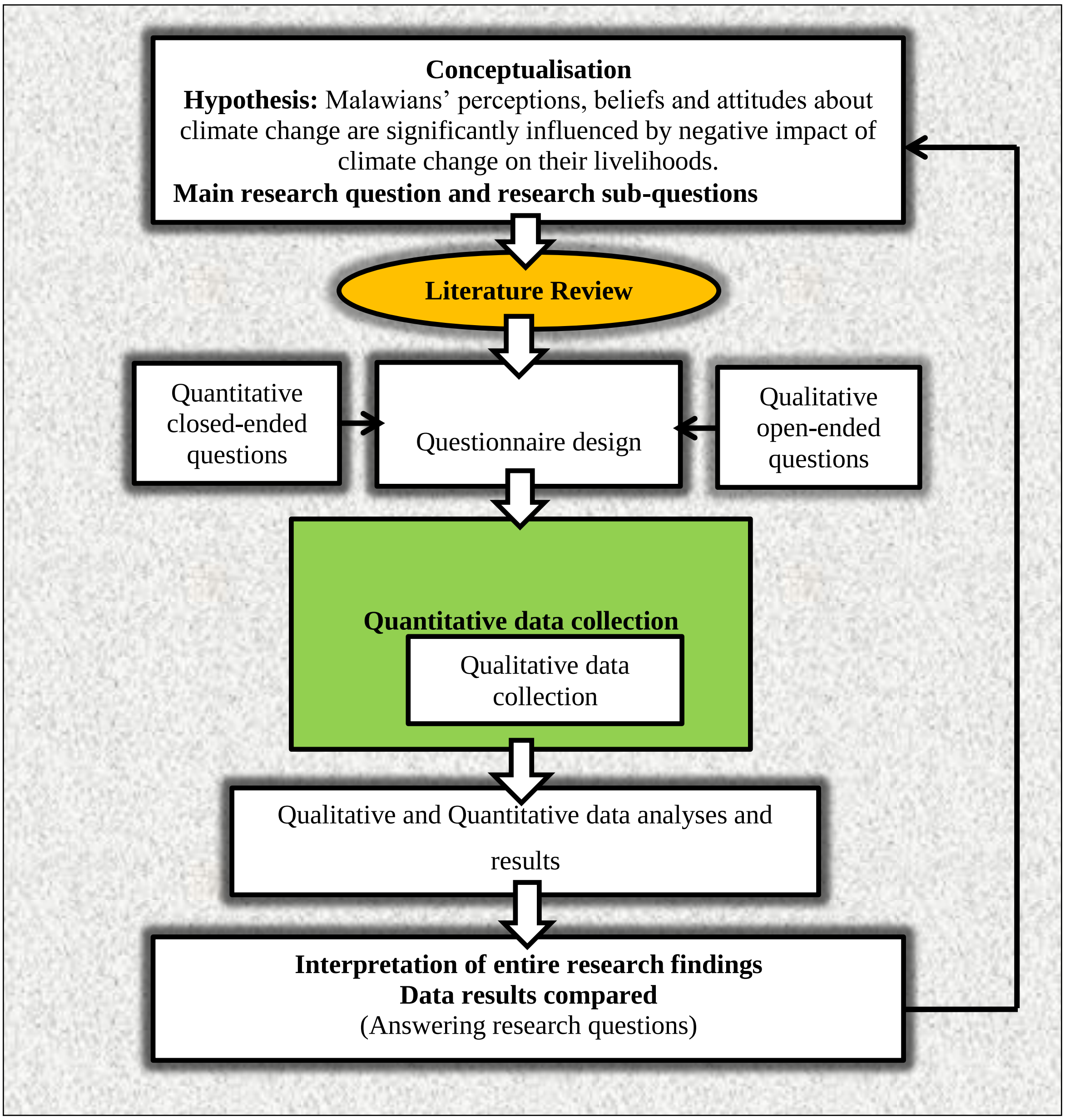

Figure 4.1: Mixed-methods approach: concurrent embedded design.

Adapted from Creswell et al., (2003).

Figure 4.1 above shows that the stage of designing the questionnaire involved incorporating open-ended and closed-ended questions to compile a single data-collection instrument— a semi-structured survey questionnaire. The next stage indicates that both quantitative and qualitative data would be collected simultaneously, from the same sample and using the same instrument— the semi-structured questionnaire. Open-ended questions would be used to capture the qualitative data while closed-ended questions would be used to capture the quantitative data. It is worth noting that in the context of this study, quantitative research is the predominant method, while qualitative research is the secondary method. After the data collection, the open-ended and closed-ended responses would be integrated during analysis, and this would be followed by interpretation of results. The interpretation of research findings would utilise both quantitative and qualitative results to provide a broader perspective. The arrows indicate the kind of connection between the stages with one stage leading to the other. The ultimate goal was that the interpretation/synthesis of research findings should answer research questions.

While the quantitative survey results would help us measure and describe perceptions, beliefs, and attitudes of the selected sample and be able to generalise this to the entire Malawi adult population, the qualitative research was aimed at describing and understanding the social context of study i.e., contextual factors that influence Malawians' understanding of climate change (see Babbie, 2012; Babbie & Mouton, 2001). Qualitative research is important when a researcher wants to understand native concepts or the phenomenon being investigated (see Kempton, 1991; Vaughn, Schumm & Sinagub, 1996; Babbie & Mouton, 2001). This means that while quantitative results would provide a broader picture of Malawians' understanding or misunderstanding of climate change (scientific literacy about climate change), qualitative results, on the other hand, would reveal the contextual factors that influence Malawians' understanding of climate change. So, given that there are some contextual factors that shape Malawians' understanding of climate change, this approach (concurrent embedded mixed-methods design) would enable us to compare the qualitative and quantitative databases to determine whether there is confirmation, disconfirmation, cross-validation, or corroboration (Creswell, 2009).

4.4 Questionnaire design and pre-testing

Data were captured using a semi-structured survey questionnaire i.e., a data collection tool with open-ended and closed-questions (see Appendix 1). As explained in Section 4.3, in order to address the research questions it was imperative to collect both qualitative and quantitative data. Babbie and Mouton (2001) state that quantitative surveys are useful for measuring and describing people's attitudes, perceptions, and beliefs in a population too large to observe directly. However, quantitative research is rarely appropriate in answering *why* and *how* questions; rather these sort of questions are best answered using qualitative research as this provides a contextual understanding of the phenomenon under investigation (Vaughn et al, 1991; Babbie & Mouton, 2001; Nieuwenhuis & Smit, 2012). Mentz and Botha (2012) say that open-ended questions are typically used in surveys to collect qualitative data, as they are quite useful if a researcher would like to obtain an in-depth exploration and understanding of a topic or an issue.

The questionnaire design draws on methodologies and findings of previous research on the public understanding of climate change (e.g., Kempton, 1991; Stoll-Kleemann et al., 2001; BBC World Service Trust, 2010; Bostrom et al., 1994; Bord et al., 1998; O'Connor et al., 1999; Bord et al., 2000; O'Connor et al., 2002; Lorenzoni et al., 2005; Ohe & Ikeda, 2005; Lorenzoni & Pidgeon, 2006; Lorenzoni et al., 2006; Lorenzoni et al., 2007; Zahran et al., 2007; Sterman & Sweeney, 2007; Brody et al. 2008; Eurobarometer 2009, 2011; Whitmarsh, 2009; Li et al., 2011; Spence et al., 2011; Egan & Mullin, 2012). These studies reveal that there are a number of factors that influence people's understanding of climate change including demographic, attitudinal, social contextual and geophysical factors. Thus some of the questions were adapted from these studies while others, especially the open-ended questions, were designed to understand the contextual issues regarding climate change.

The questionnaire has a total of ten pages comprising closed-ended and open-ended questions. On the first page of the instrument is the subject of the survey. Then, the researcher is introduced and respondents are informed about the purpose of the study. The respondents are also informed that they have been selected to participate in the study because they are an adult and head of a household living in Malawi, and that their participation is voluntary. They are also assured that their identities would remain anonymous and that their names would not be linked to the results of the study in any way.

The questionnaire consists of six sections:

- *Awareness, understanding and knowledge of climate change*: This section has general, closed-ended and open-ended questions about people's experience, awareness, understanding and knowledge of climate change issue. These questions were purposely placed at the beginning of the survey not only to introduce and contextualise the study, but also to avoid biasing their responses to the subsequent closed-ended questions. Most of these questions were adapted from previous studies (e.g., BBC WST, 2010; Kempton, 1991). In this section, as in subsequent sections, I use a few contingent questions. For instance, those who answered 'yes' to question 1 would then go to question 2, but those who answered 'no' to question 1 would skip question 2 and answer question 4. This means that questions 2 and 3 were only to be answered by those who answered 'yes' to question 1. Contingency questions help respondents answer questions that are relevant to them (Babbie & Mouton, 2001). To test the validity or truthfulness of survey data, I performed bivariate analyses on all the contingency questions. Thus, to some extent the contingency questions have been used as control or third variables.
- *Perceptions, attitudes, and beliefs about climate change*: This section is the largest with 21 matrix questions, all of which are answered on a Likert scale, aimed at soliciting respondents' attitudes, beliefs and attitudes towards climate change and related issues. Likert-scale questions require respondents to make a decision on their level of agreement with a statement, generally on a five-point scale (i.e., strongly disagree; disagree; neither agree nor disagree; agree; and strongly agree). Some of the questionnaire items (q25c, q25g, q25k, q25o, and q25l) were adapted from Spence and colleagues (2011).
- *Assessing concern about climate change, and concern about climate change in relation to other socioeconomic and environmental problems*: While some of questions in this section (q17, q18 and q19) use a matrix format, others (questions 20, and 21) do not. Questions 17, 18 and 19 were adapted from previous studies (e.g., Bord et al., 2000; Shisanya & Khayesi, 2007; Eurobarometer, 2009, 2011).
- *People's livelihoods and assessing impact of climate change on the livelihoods*: This study would be incomplete if it had not included questions about people's livelihoods and an assessment of how climate change has affected their livelihoods. This section comprises questions 26 through to 31.
- *Willingness to support climate change policy and whether action has been taken to address climate change, and the nature of action taken to address climate change:*

The questions in this section (question numbers 22, 23, 24, 30, 31, and 32) assess how willing respondents are to support national climate change (should the Government of Malawi develop it) and what action respondents have taken to address climate change. There are two open-ended questions in this section.

- *Socio-demographic measures*: These include age, gender, marital status, ethnicity, whether a respondent has children, number of children, nationality, occupation, monthly household income, highest level of education, highest level of education in science-related subject, religion, attendance to religious activities, number of household members and political ideology. Space is provided for participants to indicate their highest level of education in science-related subjects and their occupation. The last question (question number 48) asks for comments about the survey.

There are a few open-ended questions included in the questionnaire. These questions solicited qualitative data ranging from what changes in weather, climate, and environment the respondents had experienced or noticed over the past ten years, why they think these changes are occurring, how they are addressing the negative impact of climate change (if the respondents agree that climate change has had negative impact on their livelihood) to general comments about the issues raised in the questionnaire.

After designing the questionnaire, I hired a language translation expert to translate the questionnaire into Chichewa—a language that is spoken and understood virtually by every Malawian, irrespective of cultural, ethnic and regional boundaries, to cater for rural respondents.

Vaus (1996) and Babbie and Mouton (2001) stipulate that once a questionnaire has been developed, it should be evaluated rigorously before being administered. This is called questionnaire pre-testing or pilot testing. Unfortunately pre-testing a questionnaire is rarely done by many social researchers (Babbie & Mouton, 2001). Vaus (1996) argues that besides testing individual questions, the following four things should also be thoroughly checked when pilot testing a questionnaire: flow, missed questions, timing, and respondent interest and attention. The survey questionnaire was pilot tested with a sample of ten participants selected from the cities of Blantyre and Zomba in January 2013 to establish content validity of the instrument and reliability of data. Clearly, the selection of these participants was not representative (the minimum qualification of the participants was a bachelor's degree and the highest qualification was a doctorate degree). However, other characteristics such as gender, age, ethnicity, religion, marital status, and employment status were considered. The respondents were clearly informed that the primary aim of the pre-test was to check for errors and clarity of the questionnaire items, flow, missed questions, timing and their interest and attention. Though the sample was not representative, this exercise improved the clarity of the instrument as the researcher received invaluable feedback from at least four of the respondents. Their comments were incorporated when the questionnaire was later revised. It was noted that it took on average thirty (30) minutes to complete a questionnaire. This helped in the planning of the large-scale study.

4.5 Recruitment and training of research assistants

The study used a face-to-face interview survey method to collect the data. This requires interviewers to ask questions orally and record the answers given by a respondent (Babbie, 2012; Babbie & Mouton, 2001). Since the nature of the study required data to be collected from urban and rural areas (where educated and mostly white-collar employees, and the less literate and mostly farmers live, respectively) research assistants (or interviewers) were needed to help with collecting data. It was envisaged that data collection exercise would be easier in urban areas because these respondents are educated and would therefore be able to understand and complete the questionnaires themselves. However, this is not the case in rural areas where the majority of the people are illiterate.

There are a number of advantages of having a questionnaire administered by interviewers rather than allowing the respondents to complete a survey in their own time. Among other things, interview surveys generally have a higher completion rate, usually of at least 80-85%; have higher response rates than mail surveys; minimize non-responses, “don’t knows” and “no answers” to questionnaire items; and interviewers can clear up misunderstandings and clarify questions, thereby obtaining relevant responses and enhancing the high response rate (Babbie & Mouton, 2001; Mentz & Botha, 2012).

Six young men were recruited as research assistants or interviewers for the study. Four of them were college students, while two were graduates. The fieldwork coincided with the college vacation and this ensured that the data collection process would be uninterrupted. The six underwent a two-day training session on the 19th and 20th February 2013. Training of interviewers is considered one of the quality control measures in an interview survey (Babbie, 2012; Babbie & Mouton, 2001). Among other things, this training was aimed at familiarising the interviewers with the questionnaire, their role as interviewers, how they should conduct and present themselves to the respondents, how to record responses, how to probe for responses and clarify certain questions. It was also an opportunity for them to practise their interviewing skills, and to make them aware of some of the practical issues and logistics of the data collection process. This session proved worthwhile to the researcher as well as the research assistants pointed out some issues relating to the phrasing of some of the questions. Consequently, some changes were made to the questionnaire.

4.6 Sample design and sampling procedures

The sections below discuss some of the sampling processes used. Both probability and non-probability sampling techniques were used to draw the required sample from both the rural and urban areas, while taking into account the gender distribution of the population in Malawi. Arguably, this study is representative of the Malawian adult population because almost all major characteristics of the population such as gender, educational qualifications, age group, ethnicity, religion, and occupation/livelihood are represented in the sample. See Table 4.2 for a summary of the spatial distribution and demographic profile of the participants.

4.6.1 Study population and sample size

A map of Malawi (see Figure 4.2), a landlocked country in southeast Africa, is provided as background information. Malawi has a total population of 13, 077, 160; fifty per cent of whom are aged 18 years or older (NSO, 2009). The median age of the Malawian population is 17 years.

A national study was implemented with a face-to-face interview questionnaire survey of a representative sample (N=290) of the Malawian adult population i.e., those aged 18 years and older who are also heads of households. Note that the initial plan was to have a sample size of 300 for the study and achieve a 100% questionnaire completion rate. However, the questionnaire response rate was 96.6% (290). The sample was drawn from all the three regions of Malawi, namely Northern region, Southern Region and Central Region.

The selection of participants was done at the household level, and only one member of the household designated as the head of the household, either a male or a female, would be selected as a participant in the study. The justification for doing this was that some questions could only be answered appropriately by a household head because of the perceived traditional role the head plays. For example, survey questions 26, 43 and 45 (see Appendix 1) are addressed to the head of the household and not to any other member.

It is generally accepted that deciding on a sample size for a study is a matter more of judgement than calculation (Hoineville, Jowell & Associates, 1978: 61). The decision to have a sample size of 300 was primarily determined by the purpose of the survey. As stated earlier, the aim of the study was to identify and investigate factors that influence Malawians' perceptions, attitudes and beliefs about climate change. A sample size of 300 was considered large enough to be representative of the Malawian public. Hoineville, Jowell and Associates (1978: 56) argue that "a decision about the survey population stems more from the purpose of the survey than from sampling considerations, though these may influence it".

Indeed, some sampling considerations influenced the decision to have a sample size of 300, and these included effect size and power analysis; confidence level and margin of error; and the ease of performing certain statistical analyses, such as measuring group differences, discovering differences, associations, chi-square, and factor analysis.

According to Cohen (1988), a sample size of 300 has an effect size of 0.20 (r =0.20) and power of 0.80 (d =0.80) (Cohen, 1988: 102). Another important consideration when determining sample is the level of confidence and the standard error often manifested in the margin of error. Accordingly, a sample size of 267 would have a level of confidence of 95 per cent and margin of error of ±6 per cent (Rea & Parker, 2005: 147). A sample size of 300 (N=300) has the same percentage of level of confidence and margin of error as that of a sample size of 267[16]. Most surveys determine their sample sizes on the basis of a confidence level of 95 per cent (Hoinville, Jowell & Associates, 1978: 59).

It is also worth pointing out that some statistical analyses can only be performed if the sample size is large enough. Van Voorhis and Morgan (2007) do offer some statistical rules of thumb

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[16] For a better understanding of the formula and calculations involved in determining the sample sizes, see Rea and Parker's (2005) *Designing and Conducting Survey Research: A comprehensive guide* (3rd edition, pp145-148).

to guide researchers in their selection of sample sizes large enough for sufficient power to analyse differences, associations, chi-square, and to perform factor analysis. See Table 4.1 below.

From Table 4.1 below, it is clear that a sample of 300 is large enough to perform a number of statistical analyses including discovering relationships among variables, measuring group differences, chi-square and factor analysis.

Table 4.1: Sample size rules of thumb

Relationship	**Reasonable sample size**
Measuring group differences (e.g. t-test, ANOVA)	Cell of 30 for 80% power, if decreased, no lower than 7 per cell
Relationships (e.g., correlations, regression)	~50
Chi-square	At least 20 overall, no cell smaller than 5
Factor Analysis	~300 is “good”

Table 4.1 is adapted from Van Voorhis & Morgan (2007: 48).

4.6.2 Study areas

The survey was conducted across all the three regions of Malawi, namely the Southern, Central and Northern regions (see Figure 4.2). Due to limited finances and time constraints, four cities and eleven rural districts from the three regions were purposively selected for the study.

Malawi has a total of 28 districts spread across the three regions, namely: Northern, Central and Southern regions. Of the 28 districts, 6 (Chitipa, Karonga, Likoma, Mzimba, Nkhata Bay, and Rumphi) are located in the Northern region, 9 (Dedza, Dowa, Kasungu, Lilongwe, Mchinji, Nkhotakota, Ntcheu, Ntchisi and Salima) are in the Central Region, and 13 (Balaka, Blantyre, Chikhwawa, Chiradzulu, Machinga, Mangochi, Mulanje, Mwanza, Nsanje, Thyolo, Phalombe, Zomba and Neno) are located in the Southern Region. Additionally, Malawi has four major cities, namely: Lilongwe, Blantyre, Mzuzu and Zomba.

Available at: http://www.nationsonline.org

Figure 4.2: A map of Malawi

A credible survey is one whose sample size is representative of the entire population. In order to obtain a representative sample of the Malawian adult population, it was decided that respondents needed to include those living in urban and rural areas. Malawi has four major cities, namely: Lilongwe (capital city), Blantyre, Zomba and Mzuzu. Blantyre and Zomba are located in the Southern Region, while Lilongwe and Mzuzu are located in the Central and Northern region, respectively. Urban respondents were selected from these four cities, while rural respondents were drawn from a total of eleven districts selected across the three regions, namely: Zomba (rural), Mangochi, Chikhwawa, Mulanje, Blantyre (rural), Lilongwe (rural), Kasungu, Ntcheu, Salima, Mzimba and Nkhata-Bay.

4.6.3 Selection of rural areas

The eleven districts were purposively selected based on the predominant agricultural and economic activities that take place there. Indeed, most agricultural and economic activities are sited at specified areas within the district, which is why the selection of villages was done at the Traditional Authority (T/A) level, followed by selection of a household at village level.

Five districts were selected from the Southern Region. In Zomba, Likapa and Nyangu villages (T/A Mwambo and T/A Kuntumanji, respectively) were selected because these are located around Lake Chilwa where most of the inhabitants earn a living through fishing and fish-related business. In Mulanje, Bango and Mbelemuno villages (T/A Mabuka) were selected because most of inhabitants there are predominantly maize, tea and banana farmers while some are employed as temporary workers at the nearby Eldorado Tea Estate. In Mangochi, Chipoka and Mpemba villages (T/A Mponda) located along Lake Malawi were selected because most of the inhabitants there were likely to be fishermen and business people. In Chikhwawa, Chikalumpha and Chikhambi villages (T/A Katunga and T/A Kasisi, respectively) located in the lower Shire River valley were selected because most of the inhabitants grow cotton, millet, maize and sorghum, in addition to animal farming. Mdeka and Lirangwe areas (T/A Chigaru) were selected because most of the inhabitants there are farmers and business people.

Four districts were selected from the Central Region of Malawi. Kasamba and Galeta villages (T/A Njolomole) in Ntcheu were selected because the inhabitants are predominantly farmers, specialising in maize, tomatoes, groundnuts, beans and Irish potatoes. Nguluwe, Ndemeka and Madetsa villages (T/A Mazengera) in Lilongwe were selected because the inhabitants are predominantly tobacco, maize, groundnut and bean farmers. Njomani and Mwambo (Sub-Traditional Authority Mphomwa) in Kasungu were selected because the inhabitants there predominantly farm tobacco and maize. Mnenga and Sandu villages (T/A Ndindi) in Salima and located along Lake Malawi were selected because most people's livelihoods there are dependent on fishing, business and the growing of cotton and maize.

Two districts were selected from the Northern region. Chizonga and Kalindiza villages (T/A Malanda and T/A Malenga Mzoma, respectively) in the lakeshore district of Nkhata Bay were selected because most of the inhabitants were likely to be fishermen, businesspeople and farmers. Lastly, Peter Ndabandaba group village headman (GVH), Kadomeka Nyirenda, Jobu, Chipeta Nyirenda, and Bondera Chipeta villages in Mzimba were selected because most of the inhabitants there grow maize and sweet potatoes, and some of the inhabitants (except in Peter Ndabandaba GVH) are employed as temporary workers at the nearby Raiply Malawi Limited (a timber processing company that manages the Viphya man-made forest plantation occupying 53, 000 hectares of land in Mzimba).

As expected, most of the rural respondents (198) are farmers, 73 are business people, 15 are fishermen (9 from Zomba, 2 from Mangoch, 3 from Nkhata Bay, and 1 from Salima), 5 are civil servants, 5 are employed by the private sector, and 65 of them do piecework.

4.6.4 Selection of urban areas

Urban respondents were selected from the four cities of Lilongwe, Blantyre, Mzuzu and Zomba. In line with the purpose of the study, it was important that the urban sub-sample should constitute those who are well educated (at least a minimum qualification of a diploma) and employed, or established business people. This meant selecting those suburbs where Malawi's upper, upper-middle and middle classes live. In Zomba city these classes normally reside in Chirunga, Mangasanja, Mulunguzi, Old Naisi, Matawale and St Mary's. In Blantyre city these classes can be found in Nyambadwe, Namiwawa and Sunnyside, among other residential areas. In Lilongwe city the upper, upper-middle and middle classes dwell in Area 9, Area 10, Area 15, Area 24, Area 25, Area 36, Area 47, Area 49 and Chilinde Newlines, among other areas. In Mzuzu city these classes can be found in Luwinga, Chimaliro, Katoto Newlines, Kaning'ina, and Lusangazi, among other residential areas.

Indeed as expected, all but one urban respondent has either a diploma, a degree or a doctorate as their highest qualification compared to the rural respondents, the majority of whom have only a primary school education. Specifically, 18 have a diploma, 32 have one degree, 22 have a master's degree and 3 have a PhD. Only one urban respondent has a Malawi School Certificate of Education (MSCE),[17] and moreover, the respondent's monthly household income is MK75, 000-MK100, 000[18]. There was only one rural respondent with a diploma, a teacher at a secondary school in rural Blantyre. It is quite evident that an individual's

[17] Malawi School Certificate of Education is equivalent to the International General Certificate of Secondary Education (IGCSE). In order to be awarded an MSCE an individual must pass any six subjects including a credit pass in English.
[18] At the time of data collection, 1 United States dollar (1US$) was equivalent to 294 Malawi kwacha (MK294).

academic qualifications determine one's opportunities in the job market. Comparatively, most of the urban respondents are employed as teachers, lecturers, managers, bankers, or other white-collar jobs. Of the rural respondents, only three are teachers and one has white-collar employment. Again, comparatively, the urban respondents have a considerably higher monthly household income than the rural respondents. The highest monthly household income for urban respondents is over MK400, 000 and the lowest monthly household income is MK30, 001-MK75, 000. The highest household income for rural respondents is MK75, 001-MK100, 000 (there are only 3 of them in rural areas compared to 23 in urban areas) and the lowest monthly household income is under MK15, 000.

Another important finding is that 21 urban respondents indicated that business is also their livelihood while 12 indicated that farming is also their livelihood. This means that urban dwellers have multiple streams of income and do not just depend on their white-collar jobs. This finding has serious implications for this study, especially for understanding the relationship between the impact of climate change on an individual's livelihood and one's perceptions, beliefs and attitudes about climate change. I shall discuss this and other findings later in Chapter 5.

4.6.5 Selection of participants

The selection of a respondent at household level was done by following a number of sampling procedures. At the first level, proportionate stratification was used to select the three geographical and administrative regions of Malawi. These are Southern, Central and Northern regions.

At the second level, disproportionate stratified sampling based on the rural-urban population distribution was used to select the number of rural and urban respondents. According to *The Malawi Population and Housing Census 2008 Main Report* (NSO, 2009), Malawi has a total population of 13, 077, 160; 15.3% of whom live in urban areas[19] and the rest (84.7%) live in rural areas. Malawi's economy is agro-based and the majority of the population (84.7 % of the population who live in rural areas) depend on rain-fed agriculture. The sampling needed to

[19] In Malawi, urban areas refer to the four cities of Lilongwe, Blantyre, Mzuzu, and Zomba and other urban areas, which consist of Bomas (28 of them) and gazetted town planning areas (see NSO's *Population and Housing Census 2008 Main Report*, 2009. p8). In the context of this study, the NSO's classification of urban areas is maintained.

take this rural-urban population distribution into account. Malawi has four major cities, namely Lilongwe, Blantyre, Mzuzu and Zomba, meaning that the sample would have 45 urban respondents and 255 rural respondents. However, it was then decided that a sample of 45 was too small for separate analysis. It was therefore decided that the urban sub-sample needed to come from the four major cities, which translated into 20 respondents per city. Thus the total number of urban respondents was 80, while that of rural respondents was 220. In other words, the urban sample was over-represented in the study, and the rural sample was under-represented. However, both sample sizes were large enough for separate analysis. This process of over-representing an urban sample by employing a larger sampling fraction than in the rural sample makes use of what is referred to as variable sampling fractions (Hoinville, Jowell & Associates, 1978). Variable sampling fractions are mostly used to over-represent a small stratum as well as to "improve the overall efficiency of a sample design where interviewing costs or the variability of responses are known or expected to differ between strata" (Hoinville, Jowell & Associates, 1978: 64).

At the third level, proportionate stratification was used to determine the gender distribution of the sample. The gender ratio in Malawi is 94.7[20] (NSO, 2009). This means that Malawi's population has more women (51.4%) than men (48.6%). A sample size that represents both males and females should also take into account the gender distribution of a population. This means that the sample should have had 149 women and 141 men. However, the actual sample consisted of 154 women (53.1%) and 136 men (46.9%). This means that women were over-represented by 1.7%. Since this gender distribution almost reflected that of the census, this result could be considered representative.

The fourth level involved the selection of districts from all the three regions of Malawi. The selection of the districts was purposive. Eleven districts were selected based on the predominant agricultural and economic activities there. It was decided that the rural areas should have an equal number of participants. And because the sub-rural sample was 220, it meant having 20 rural participants from each selected district.

Fifth level involved selection of Traditional Authority (T/A). In Malawi every district has several T/As. These T/As are further divided into villages. Due to time and financial

[20] Gender ratio is defined as the number of males per 100 females.

constraints, only one or two T/As would be purposively selected depending on the dominant agricultural and economic activities in the area.

The sixth level involved selecting villages. In Malawi rural people live in villages and all the villages in Malawi are under the jurisdiction of a Traditional Authority (T/A). The criterion used for selecting a village was the same criterion that was used to select a district. In most cases the dominant agricultural and economic activities at district level was a reflection of what was happening at the village and household levels. Thus, the selection of households within respective districts was not done haphazardly.

The seventh and final level involved selecting one head of a household per village to participate in the study. Where there were both male and female heads of households willing to take part in the study, a participant was selected based on the gender ratio for that particular district. For instance, Mulanje district has a gender ratio of 87.9, meaning that the district is 43.8% male and 56.2% female. This implied that only 4 men and 6 women were selected as participants. So, if a village in Mulanje district was purposively selected, it meant that only 4 men and 6 women were randomly selected as participants in the study.

4.7 Fieldwork practice and challenges encountered

Much as the purpose of the study was academic, it was necessary to make authorities at district and city council levels (i.e., the District Commissioner (DC) and the Chief Executive Officers) aware of the study in their respective areas of jurisdiction. After introducing myself and the team of research assistants to the officials and articulating the purpose of the study, the authorities were asked to provide written permission for us to carry out the study in their areas (see Appendices 10 and 11). It was also culturally correct to inform the village head (particularly in rural areas) of the purpose of the study before interviewing their subjects. Again, all the respondents were informed of the purpose of the study and their informed consent was sought. Only after these protocols were observed did we select the participants and commence interviewing.

Data was captured using a semi-structured questionnaire. Upon arriving at a household, interviewers would enquire about the composition of the household, and whether the head of the household was available. Once this was confirmed, the head of the household was informed that their participation in the study was voluntary and they were asked to give their consent before proceeding with the interview. The participants were asked whether they were able to complete the questionnaire by themselves or whether they needed the interviewer to record their responses. Unsurprisingly, all the urban respondents completed the questionnaires on their own, while almost all the rural respondents requested the interviewers to record their responses.

For practical purposes, it was decided that the data collection in the urban areas should be done between 17:00 and 19:00, especially from Mondays to Fridays. The reasoning for this was that this would be the ideal time to find respondents at home, since most of them would be busy during the day. In some cases, interviewers left the questionnaires with the respondents in the evening and collected them the following morning. However, in the rural areas the exercise took place during the day (i.e., from 08:00 until 17:00). As a token of appreciation for giving up their time and allowing us to interview the respondents (particularly the rural respondents), we gave each respondent a 1 kg packet of sugar or a soft drink and a snack.

During the data collection exercise we faced a few challenges. The initial sample size was 300. However, I ended up having 290 participants who completed the questionnaires. A number of factors accounted for this. First, I discovered that the research assistants had included as participants three young men (one from Mangochi, two from Blantyre city) who were not heads of households. I then decided to disregard these completed questionnaires in the analysis. Second, it was not easy to get the required number of participants in Mzuzu city. We were supposed to interview 20 participants; however some residents refused to take part in the study. As a consequence, we ended up with 18 respondents from Mzuzu city. The last challenge was that there were five incomplete questionnaires. This was only discovered at the stage of capturing the data. The interviewers' reports indicated that the respondents simply could not provide the answers to the questions, hence the incomplete questionnaires. One questionnaire was from Zomba rural, another was from Lilongwe rural and three were from Mulanje rural. Thus altogether there were ten questionnaires that were disregarded for analysis, thereby reducing the number of completed questionnaires to 290 (214 rural respondents and 76 urban respondents). This means that this study had achieved an overall completion rate of 96.6%, far above the average completion rate of interview surveys which is between 80% and 85% (see Babbie & Mouton, 2001; Babbie, 2012).

It is worthwhile pointing out that as a quality control measure I accompanied the interviewers to all the study areas. Data collection in all the eleven districts of Malawi was done from 20th February to 10 March, 2013, a period of two weeks.

4.8 Interviewer debriefing session

An interviewer debriefing session took place a day after the fieldwork was completed on 11th March, 2013. Besides the daily reports that interviewers submitted, it was necessary to provide an opportunity for interviewers to express their views, to tell of their experiences and interpretation of the whole data collection exercise (Babbie & Mouton, 2001). In addition to meeting friendly and welcoming respondents, four of the interviewers said that some of their respondents, particularly in Chikhwawa, Mulanje and Nkhata Bay districts prepared delicious meals for them! While three of the interviewers were experienced in survey data collection, three of them said this exercise was an eye-opener, and had afforded them an opportunity to get to know new places. All six interviewers were grateful for being considered as research assistants for the study because they also earned considerable income for the work.

4.9 Data reduction and analysis

This section outlines the steps that were taken in analysing both the qualitative and quantitative data. The quantitative data were entered in Microsoft Excel and then imported into SPSS for analysis (SPSS is an acronym for a computer programme - ‘Statistical Package for the Social Sciences’). To reiterate, the open-ended and closed-ended responses were integrated during analysis. There are a number of other computer packages available for analysing quantitative data, however, SPSS was chosen because, apart from being a relatively user-friendly computer software package, it is “possibly the most widely used computer software for the analysis of quantitative data for social scientists” (Bryman, 2008: 340). The qualitative data was analysed using content analysis. Content analysis is a technique that may be used to analyse either qualitative or quantitative data. Krippendorff (1980: 21 cited in Baxter 1991) considered content analysis as “a technique for making replicable and valid inferences from data to their context”. Scholars regard content analysis as a flexible method for analysing textual data including audio, pictorial and video data. In the context of this study, emergent coding was used. Emergent coding entails establishing categories through examination of the data. These categories are subsequently submitted to statistical analysis.

Content analysis as an approach of analysing qualitative data has several advantages. Suffice to say that, in the context of this study, this technique is considered as a transparent way of coding and developing themes or categories out of the qualitative data. As a matter of fact, it is because of this transparency that some people refer to content analysis as an objective method of data analysis (Bryman, 2008: 288).

4.9.1 Quantitative data reduction and analysis

The quantitative data were analysed using SPSS. A codebook was prepared to guide the entering of the information from the questionnaires into SPSS. A copy of the questionnaire and the codebook can be found in the Appendix (see Appendices 1 and 2). Using the codebook, all questionnaire responses (open-ended and closed-ended) were then entered into Microsoft Excel and then imported into SPSS. The next step involved screening and cleaning the data. Pallant (2010) advises researchers to check the data set for errors first. The exercise—which included running and inspecting frequencies for each of the variables—helped to improve the quality of the data. Running the frequencies revealed that the percentage of missing values for almost all the variables was below 10%, except for question 16 (21.7%) and question 48 (60%). Understandably, respondents thought that these two questions were optional.

The next step involved recoding some of the variables so that certain analyses could be performed with ease. There are some analyses (chi-square, factor analysis and regression analysis) that cannot be performed with a small number of responses. Some variables that were recoded include religion (recoded into two categories); age bracket (recoded into 4 categories); ethnicity (recoded into 8 categories); monthly household income (recoded into 2 categories); number of children (recoded into 3 categories); highest level of education (recoded into 4 categories); and highest level of education in science-related subjects (recoded into 3 categories), attendance to religious activities (recoded into 3 categories), among others.

Having recoded the variables, the data set was ready for both descriptive and inferential analyses. According to Pallant (2010: 53), descriptive statistics have a number of uses, including describing the characteristics of a sample; checking variables for any violation of the assumptions underlying the statistical techniques; and addressing some research questions. There are a number of descriptive statistics that are used to describe data. They include frequency tables (i.e., mean, mode, median, variance, standard deviation, range, skewness, and kurtosis, etc.), correlation coefficient, graphs, and scatter plots. Inferential statistics, on the other hand, is used to test hypotheses and validate whether descriptive results are due to random factors or there exists a real relationship between variables. For the purposes of the study, both descriptive and inferential statistics were performed to address specific research questions. Cunningham and Aldrich (2012: 83) say that many inferential techniques require that a descriptive analysis of the variables to be conducted first. Some of statistical techniques performed therefore included chi-square, principal components analysis (PCA), and regression analysis. The logic behind performing each of these techniques can be explained. While chi-square was performed to explore relationships between categorical variables, factor analysis was performed to reveal clusters or patterns of attitudes, perceptions and beliefs about climate change among respondents. Multiple regression analysis was performed to explore interrelationships among variables (Graham, 2008; Pallant, 2010). Furthermore, by including various variables in a model and testing their predictive ability, regression analysis helped to develop a model that could be used to explain Malawians' understanding of climate change.

4.9.2 Qualitative data reduction and analysis

The analysis of the qualitative data was done in two stages. The first stage involved coding the open-ended responses using content analysis. Coding is a fundamental stage in the process of content analysis. Coding of open-ended questions has two main elements, namely: designing a coding schedule and designing a coding manual. A coding schedule is a form into which all the data relating to an item will be entered, while a coding manual is a statement of instructions to the coders that includes all the possible categories for each dimension being coded (Bryman, 2008) (see Appendix 3). A coding manual acts as a guide for coders, so after designing a coding manual, the coding schedule was completed. Two independent coders were asked to cross-check the accuracy of the completed coding schedule. The second stage involved entering the coded data into SPSS. Once the data from the nine open-ended questions in the semi-structured questionnaire had been captured in the completed coding schedule, it had to be entered into SPSS to be quantified. The section below outlines the categories of responses for each of the nine open-ended questions.

- q2: *What changes have you experienced? Please explain.* Out of a sample of 290 (N=290), 287 participants answered this question. This represents 99% response rate. This question generated 12 response categories and each code (i.e., number) corresponds to a respective category. It should be noted that the assigning of a code to a category did not signify either the importance of the category or the number of people who gave this response, but was used for sequencing purposes only, and this applies to all the other qualitative analyses in the study. The codes and respective categories were: (1) Increase and variations in temperature; (2) Erratic rainfall pattern; (3) Variability of weather pattern and seasons; (4) Insufficient rainfall and drought; (5) Heavy rainfall and flooding; (6) Late onset of rainfall; (7) Drying up of water bodies and low fish output; (8) Spread of sicknesses and diseases; (9) Poor harvest; (10) Environmental degradation; (11) Wind pattern; and (12) Other.

- q3: *Why do you think these changes are occurring? Please explain*. Out of a total sample of 290 participants (N=290) in the study, 286 participants answered this question. This represents 98.6% response rate. This question generated 13 response categories. The codes and respective categories were: (1) Natural activities; (2) Bad agricultural practices; (3) Concentration of greenhouse gases in the atmosphere; (4) Deforestation; (5) Pollution; (6) Depletion of ozone layer; (7) The will of God; (8) Overpopulation; (9) Lack of trees; (10) Apocalypse; (11) Global warming; (12) Other; and (13) I don't know.
- q9: *If 'yes' (to question 8), what do you understand "climate change" to mean?* This question was supposed to be answered by 200 respondents (N=200). Out of 290 participants only 200 answered 'yes' to question 8, but only 189 respondents answered this question. This represents 94.5% response rate. This question generated 12 response categories. These were: (1) Changes in average weather conditions over a long period of time; (2) Changes in weather patterns; (3) Changes in weather pattern, temperature and soil fertility (or crop yield); (4) Changes in weather, climate, and surrounding environment; (5) Changes in temperature; (6) Changes in rainfall pattern; (7) Changes in surrounding environment; (8) Changes in timing of rainfall; (9) Changes in rainfall pattern and movement of wind; (10) Changes in rainfall pattern and spread of sicknesses and diseases; (11) Changes in rainfall pattern and temperature; (12) Other.
- q13: *If 'yes' (to question 12), what do you think can be done to address climate change?* This question was answered by 181 respondents (N=181). Out of 290 participants, 181 respondents answered 'yes' to question 12. This represents 100% response rate. This question generated 10 response categories. There were: (1) Planting trees; (2) Avoid deforestation; (3) Avoid pollution; (4) Public awareness about climate change; (5) Praying to God; (6) Following good farming practices; (7)

Irrigation or *dimba* farming; (8) Avoid emission of greenhouse gases; (9) Control population growth; and (10) Other.

- q16: *What additional information, if any, would you like to receive/have on climate change?* This question was supposed to be answered by all members of the sample (N=290), but only 227 participants answered this question, which represents a 78.3% response rate. Most probably respondents thought this question was optional. There were 9 response categories that were generated. These were: (1) Public awareness about climate change; (2) Ways of adapting to climate change effects; (3) Ways of mitigating climate change; (4) Impact of climate change; (5) Planting trees, taking care of trees and the environment; (6) Weather and climate forecasts; (7) What the government is doing to address climate change; (8) Research done or being done on climate change issue; and (9) Other.
- q23: *If 'yes' (to question 22), what action have you done/are you doing*. This question was answered by 155 participants (N=155) and there were 155 participants who answered 'yes' to question 22, which represents a 100% response rate. Six response categories were generated from the responses. These were: (1) Planted/planting trees; (2) Raised/raising awareness about climate change; (3) Irrigation or *dimba* farming; (4) Following good farming practices; (5) Changed my lifestyle; and (6) Other.
- q31: *If 'yes' (to question 30), what is it that you have done?* This question was answered by 173 participants (N=173), all 173 respondents who answered 'yes' to question 30. This represents 100% response rate. Nine response categories were generated from the responses. (1) Planted/planting trees; (2) Raised/raising awareness about climate change and other environmental issues; (3) Following good farming practices; (4) Doing business; (5) Irrigation or *dimba* farming; (6) Doing animal farming; (7) Growing drought resistant crops; (8) Growing early maturing crops or varieties; and (9) Other.
- q32: *(If 'no' or 'not sure' to question 30) Why have you done nothing?* This question was answered by all 117 participants (N=117) who answered 'no' and 'not sure' to question 30, which represents a 100% response rate. Eight response categories were generated from the responses. These were: (1) Lack of information; (2) Lack of resources; (3) Lack of support from government, non-governmental organisations and local community; (4) Busy with work; (5) Laziness; (6) Not felt the impact seriously yet; (7) The will of God/Only God can solve climate change; and (8) Other.
- q48: *If you would like to add anything or have comments about the issues raised in this questionnaire, please write them here.* This question was answered by 116 out of

290 participants. Like question 16, respondents thought this question was also optional and so only 40% of the respondents answered question 48. This question also generated multiple responses that were coded into 11 categories. These categories were: (1) The study should help in addressing the climate change issue; (2) The need for public awareness about climate change; (3) Climate change is happening and its negative impact is being felt; (4) We need to plant trees and preserve the environment; (5) Concern about the impact of climate change to future generations; (6) The government should take a leading role in addressing climate change; (7) An appeal for material and financial support for those whose livelihoods have been affected by climate change; (8) Non-governmental organisations should take a leading role in addressing climate change; (9) Let's hold hands for us to address climate change; (10) This study has been enlightening; and (11) Other. Unexpected outcomes of the survey included its educational role and the optimism that this study would help to address climate change. It was heartening to read comments that indicated that answering the survey questions had been an eye-opener about the climate change issue for some respondents (6.9%), and that others (8.4%) expressed the hope that the results of the study would help to address climate change. As expected, a significant number of the respondents (26%) pointed out that the Government of Malawi should take a leading role in addressing climate change.

4.10 Questionnaire limitations

Both qualitative and quantitative data collection instruments have limitations. To get around this problem, a semi-structured survey instrument was used to capture both quantitative and qualitative data. Despite the fact that the semi-structured survey questionnaire was pre-tested, still there were some questions which were not answered by all the respondents (q2, q3, q9, q16, q41 and q48) and, in some cases, where questions required respondents to tick one response only (q6, q15, q17, q18, q19 and q25), they ticked more than one box. It is also clear that some questions were left out because respondents thought they were optional questions. For instance, q16 and q48 should have been answered by 290 respondents, but only 227 and 116 participants answered these questions, respectively. For one reason or other, nine urban respondents skipped q41 (highest qualification in a science-related subject). Either the respondents did not understand the question or they thought it solicited the same information as q40 (highest level of academic qualification). Obviously, omitting questions or providing multiple responses where one is required seriously affects data analysis.

Admittedly, constructing the questionnaire was not without challenges. Unexpectedly, it was discovered during data collection that some of the closed-ended questions (particularly q5 and q14) did not include all response options. Instead of having ten response categories as depicted on the questionnaire, the responses given by participants generated four more additional response categories. The additional response categories were: Formal forums; informal forums; agricultural extension workers; and non-governmental organisations. Similarly, instead of having six response categories for q14, the responses generated two more additional response categories. These were 'God' and 'Other'. The challenge in constructing a closed-ended question is that a researcher may not be sure whether all the possible response categories for the respective questions have been included. This is why when some researchers are designing closed-ended questions they include the response category *other (please specify :………)*, in case participants have additional responses.

One of the challenges of conducting a survey in a multilingual society is that of translating the survey questionnaire into a language that is easily understood by the interviewers (Babbie & Mouton, 2001). Translating the original English questionnaire into Chichewa was a challenge for the language translation expert who was hired to do this task. This problem relates to the equivalence of meaning (conceptual equivalence) (Bulmer & Warwick, 1993, cited in Babbie & Mouton, 2001).

As noted by BBC WST (2009), the term 'climate change' is difficult to translate into a number of local African languages (BBC WST, 2009:9). It is difficult to translate the term 'climate' into the Chichewa language, a Malawian language virtually spoken by the majority of inhabitants, as in Chichewa the term 'climate' literally means 'weather'. In fact, these two terms are considered to be synonyms. Thus, 'climate change' when translated into Chichewa literally means 'weather change'. This creates a conceptual problem when an individual would like to refer to only one of the two terms. To get around this conceptual issue, interviewers were instructed to explain what they mean by the terms 'climate' (or 'climate change') and 'weather' (or 'weather change') whenever they were asking respondents.

4.11 Response rate, spatial distribution and demographic profile of respondents

As pointed earlier, this study was designed to have a sample size of 300 participants, however 290 only completed the questionnaire. The study thus achieved a completion rate of 96.6%. In order to compare perceptions, beliefs and attitudes of different people about climate change, the questionnaire solicited information about the respondent's demographic characteristics (i.e., age, gender, ethnicity, marital status, whether a respondent has children, number of children, nationality, highest level of academic qualification, highest qualification in science-related subject, household income per month, religion, how often an individual attends religious activities, number of household members, occupation, livelihood, and political beliefs/ideology). Table 4.2 below gives a summary of the spatial distribution and demographic profile of study participants.

Table 4.2: Spatial distribution and demographic profile of study participants

Total number of study participants =290			
Socio-demographic characteristic of respondent		**Frequency**	**Percentage**
Category of respondent	Rural	214	73.8
	Urban	76	26.2
Region	Southern	134	46.2
	Central	98	33.8
	Northern	58	20.0
District	Blantyre	38	13.1
	Chikhwawa	20	6.9
	Lilongwe	39	13.4
	Kasungu	20	6.9
	Ntcheu	20	6.9
	Mulanje	17	5.9
	Salima	20	6.9
	Nkhata Bay	20	6.9
	Mzimba	38	13.1
	Zomba	39	13.4
	Mangochi	19	6.6
Age bracket	18-24	15	5.2
	25-34	101	34.8
	35-44	82	28.3
	45-54	51	17.6
	55 and older	41	14.1
Gender	Male	136	46.9
	Female	154	53.1
Ethnic group	Chewa	75	25.9
	Ngoni	47	16.2

Total number of study participants =290			
Socio-demographic characteristic of respondent		**Frequency**	**Percentage**
	Lomwe	29	10.0
	Sena	8	2.8
	Tonga	21	7.2
	Tumbuka	43	14.8
	Nyanja	7	2.4
	Mang'anja	19	6.6
	Yao	37	12.8
	Other	4	1.4
Marital status	Single (Never married)	14	4.8
	Married	251	86.6
	Divorced	10	3.4
	Widowed	15	5.2
Do you have children?	No	18	6.2
	Yes	272	93.8
Number of children	0	17	5.9
	1	33	11.4
	2	47	16.2
	3	52	17.9
	4	53	18.3
	5	34	11.7
	6	28	9.7
	7	16	5.5
	8 and above	10	3.4
Nationality	Malawian	290	100.0
Highest level of education	Never attended school	26	9.0
	Primary	139	47.9
	Junior secondary	29	10.0
	Senior secondary/IGCSE	20	6.9
	Diploma	19	6.6
	Degree	32	11.0
	Masters	22	7.6
	PhD	3	1.0
Highest level of education in science-related subject	Never attended school	26	9.0
	Primary	139	47.9
	Secondary certificate or A Levels	86	29.7
	Diploma or Degree	24	8.3

Total number of study participants =290			
Socio-demographic characteristic of respondent		**Frequency**	**Percentage**
	Masters	6	2.1
Monthly household income	Under MK15, 000	159	54.8
	MK15, 0001-MK30, 000	38	13.1
	MK30, 001-MK75, 000	23	7.9
	MK75, 001-MK100, 000	26	9.0
	MK100, 001-MK250, 000	24	8.3
	MK250, 001-MK400, 000	10	3.4
	Over MK400, 000	7	2.4
	Prefer not to say	3	1.0
Religion	Christian	253	87.2
	Muslim	34	11.7
	Other	2	.7
Number of children	1-3	54	18.6
	4-6	146	50.3
	7-9	78	26.9
	10 and above	12	4.1
Political beliefs	Conservative	49	16.9
	Slightly conservative	25	8.6
	Neutral	76	26.2
	Slightly liberal	11	3.8
	Liberal	74	25.5
	Don't know	55	19.0
How often do you attend religious activities?	Never	3	1.0
	Few times a year	30	10.3
	Weekly	183	63.1
	More than weekly	74	25.5

Combined Frequencies				
Demographic characteristic		**Responses**		**Percentage of cases**
Occupation	Farmer	207	44.2%	71.6%
	Fisherman	16	3.4%	5.5%
	Businessperson	97	20.7%	33.6%
	Teacher or Lecturer	27	5.8%	9.3%
	Manager, banker or other white collar	42	9.0%	14.5%
	Blue collar	9	1.9%	3.1%
	Casual worker, pieceworker or labourer	66	14.1%	22.8%
	Church minister or Pastor	3	.6%	1.0%

Total number of study participants =290				
Socio-demographic characteristic of respondent			**Frequency**	**Percentage**
	Other	1	.2%	.3%
Livelihood	Businessperson	94	19.7%	32.4%
	Farmer	210	44.1%	72.4%
	Fisherman	16	3.4%	5.5%
	Government of Malawi employee	36	7.6%	12.4%
	Private sector employee	28	5.9%	9.7%
	Parastatal employee	16	3.4%	5.5%
	A casual worker	65	13.7%	22.4%
	Other	11	2.3%	3.8%

4.12 Reliability, validity, credibility and trustworthiness of data

Reliability and validity are crucial aspects in quantitative research (Babbie & Mouton, 2001; Bless & Higson-Smith, 2000; Field, 2009; Nieuwenhuis & Smit, 2012). While a quantitative study cannot be considered reliable unless it is valid, it is useless having an instrument that has very high validity but very low reliability (Bless & Higson-Smith, 2000; Mentz & Botha, 2012). In other words, validity refers to the quality of the data collected while reliability refers to the quality of the data collection methods (Denscombe, 2010:107). The hard truth is that if an individual collects quantitative data that is neither reliable nor valid, the results are meaningless (Mentz & Botha, 2012: 80). It is therefore necessary to strike a balance between the reliability and validity of a research instrument (Bless & Higson-Smith, 2000). While quantitative researchers tend to use the terms 'reliability' and 'validity', qualitative researchers tend to use the terms 'credible' and 'trustworthy' (Babbie & Mouton, 2001; Nieuwenhuis & Smit, 2012).

Generally, research is not value-free; nonetheless, it is critical to enhance the trustworthiness and credibility of the research. To ensure that the qualitative data was both credible and trustworthy, the researcher made sure that three conditions were satisfied. Firstly, data were collected from participants voluntarily and without influencing the setting. Secondly, the participants were assured of anonymity, and that their names would not be linked to the results in any way. Thirdly, the interpretation of results was made using both quantitative and qualitative data. In other words, triangulation of research findings was used as a strategy to ensure that the interpretation is objective (a major criticism often levelled against qualitative research is that the interpretation of findings is subjective). While qualitative data collection methods, on the one hand, are generally considered to be highly valid but less reliable (because they provide an in-depth understanding of issues under investigation, but the interpretation of data is subjective), on the other hand, quantitative data collection methods, and particularly surveys, provide reliable but less valid data. This is because the responses do not need to be interpreted. However, a researcher is also not able to check whether respondents' understanding of the questions is the same and there is no in-depth exploration of issues. This is why this study employed a mixed-methods research approach, thus, incorporating elements of both qualitative and quantitative research.

4.13 Sources of error and scope of study

The study is founded on the broader theme of PUS. The PUS has become an area of inquiry that attempts to understand the relationship between science and the public. An investigation into factors that influence people's perceptions, beliefs and attitudes towards climate change falls under a sub-theme of PUS called 'public understanding of climate change', as climate change is a scientific phenomenon yet to be fully understood by majority of people. Since the early 1990s, researchers have attempted to investigate how much the public know about climate change and factors that influence public uptake of scientific knowledge about climate change. While most of the studies have been conducted in Europe and USA (Kempton, 1991; Kempton et al., 1995; Bostrom et al., 1994; Read et al., 1994; Bord et al., 1998; Bord et al., 2000; Krosnick et al., 2000; Lorenzoni & Langford, 2001; Bulkeley, 2000; Spoel et al., 2009; Carvalho & Burgess, 2005; Carvalho, 2007; Corbett & Durfee, 2004; Farnsworth & Lichter, 2011; Malka et al., 2009; Brechin & Bhandari, 2011; Li et al., 2011; Kellstedt et al., 2008; Patchen, 2006; Patchen, 2010; Zia & Todd, 2010; Leiserowitz, 2005; Lorenzoni & Pidgeon, 2006; Lorenzoni et al., 2006; Lorenzoni et al., 2007; Brody et al., 2008; Dunlap and McCright, 2008; Whitmarsh, 2009; Reynolds et al., 2010; Weber, 2010; Weber & Stern, 2011; McCright & Dunlap, 2011; McCright, 2011; Poortinga et al., 2011; Spence et al., 2011; Egan & Mullin, 2012; Smith & Leiserowitz, 2012), few of these (Shisanya & Khayesi, 2007; BBC WST, 2010) have been done in Africa. More research about public understanding of climate change in Africa is warranted. This study is an attempt to close up this research gap.

The study is modest in its scope, magnitude and approach. While employing a mixed-methods approach and with a sample size of 290 (N=290), it investigated factors that influence/shape public perceptions, attitudes and beliefs about global climate change in Malawi. Suffice to say, the quantitative aspect of the study weighs more than the qualitative aspect. It would have been interesting if a more in-depth qualitative study was conducted along with a closed-ended questionnaire survey by transforming all the closed-ended question items into open-ended qualitative questions. Such a study would have brought out more contextual issues about the public understanding of climate change in Malawi.

This study is not the first to investigate factors that influence public perceptions, beliefs and attitudes about climate change. Several studies have been carried out to investigate not only factors that influence public understanding of climate change, but also how the various factors influence willingness and support for climate change policies. Studies have found that a number of factors do influence public understanding of climate change, including gender, age, the media, socioeconomic status, source of information, mental models, risk perceptions, worldviews, gender, level of education, level of science education, affective imagery, psychological distance, political ideology, national wealth, and local knowledge and values, among others. However, this study could be considered as the first systematic study to investigate some of the factors that influence public perceptions, beliefs, and attitudes about climate change in Malawi.

CHAPTER 5

PUBLIC UNDERSTANDING OF CLIMATE CHANGE IN MALAWI

5.1 Introduction

This chapter presents and discusses the key findings of the study on Malawians' perceptions, attitudes and beliefs about climate change. Specifically, the chapter answers the following three research questions:

(i) What does the public in Malawi know and understand about climate change?

(ii) What perceptions, beliefs and attitudes do people have about global climate change?

(iii) Does the perceived impact of climate change on the livelihood of rural Malawians influence their perceptions, beliefs and attitudes towards climate change?

In order to answer these questions, an interpretation of the findings from both the qualitative and quantitative analyses is presented and compared to provide a wider perspective of Malawians' understandings of climate change. The chapter also highlights the relationships between socio-demographics, sources of information about climate change, trustworthiness of sources of information about climate change, and other variables with perceptions, beliefs and attitudes towards climate change.

In order to determine whether there is a relationship between two variables, researchers perform cross-tabulations, and the Pearson's chi-square test is used to establish whether the variables are independent. For practical purposes, the study uses the abbreviations *, **, and ***, to indicate when the *p*-value is significant (0.01-0.05), very significant (0.001-0.01), and extremely significant (<0.001), respectively. A discussion of the results of the chi-square analyses will also be presented and, where applicable, the findings of the analyses are compared with those of previous research.

The discussion of the findings in this chapter is organised around these five main themes:

(1) Awareness, understanding and knowledge of climate change;

(2) Perceptions, attitudes, and beliefs about climate change;

(3) Assessment of concern about climate change, and concern about climate change in relation to other socioeconomic and environmental problems;

(4) People's livelihoods and assessment of the impact of climate change on the livelihoods; (5) Responsibility for addressing climate change and assessment of willingness to support the implementation of the Malawi National Climate Change Policy.

5.2 Awareness of changes in weather, climate and environment over the years through personal experience

Like some studies on the public understanding of climate change (e.g., Kempton, 1991; BBC WST, 2010), study participants were asked about their experiences, understanding and knowledge of weather, climate and environment. The first question of the questionnaire (see Appendix 1) asked, "Have you experienced or noticed changes in weather, climate, and environment over the years (say, from January this year to about ten years ago)?" and 287 respondents (representing 99%) said 'yes' and only 3 respondents (1%) said 'no'. The distribution of the responses indicates that the majority of the respondents have direct, sensory evidence that the weather, climate and environment have changed over time. Indeed some studies (including BBC WST, 2010) note that personal experience or observation constitutes most Africans'knoweldge of climate change and Malawians are no exception.

5.3 Changes Malawians have experienced in their weather, climate and environment over time

It is one thing for an individual to acknowledge having personally experienced or observed changes in the weather, climate and environment, and another to actually describe these changes. Thus the second question of the questionnaire follows up by asking: "What changes have you experienced? Please explain." All the 287 respondents said something about the changes in the weather, climate and environment that they had observed over the years. As expected, respondents gave multiple responses, and at times the mentioned changes that were possibly of two different natural phenomena. Upon analysing the contents of the responses, the broad categories of changes experienced or noticed by respondents include:

- increase and variations in temperature;
- erratic or unpredictable rainfall pattern;
- variability of weather and seasons;
- insufficient rainfall and drought;
- heavy rainfall and flooding;

- late onset of rainfall;
- drying up of water bodies and low fish output;
- spread of diseases; and
- poor harvests and environmental degradation.

Rather unsurprisingly, the majority of respondents mentioned erratic or unpredictable rainfall patterns (62%). This finding was expected because the majority of populations in Africa depend on rain-fed agriculture for their livelihood. Other climatic changes respondents observed include:

- increase and variations in temperature (28%);
- variability of seasons (22%);
- insufficient rainfall and drought (18%);
- heavy rainfall and flooding (8%);
- environmental degradation (9%);
- drying up of water bodies and low fish output (4%);
- spread of diseases (4%); and
- poor harvests (2%).

Also note that about 10% talk about low fish output, spread of diseases and poor harvests as climatic and environmental changes. Most probably this is because they are convinced that these are as a result of climate change and variability. These experiences of changes in the weather, climate and environment are consistent with previous studies on African farmers' perceptions of changes in their weather and climate (Maddison, 2006; Simelton et al., 2011) and another qualitative study on public understanding of climate change in Africa (BBC WST, 2010).

The majority of Africans already perceive that the climate has become hotter and that the rainfall season has become less predictable and shorter. A study by Maddison (2006) based on data of over 9,500 farmers drawn from eleven African countries (Ghana, Kenya, Niger, Egypt, Burkina Faso, Ethiopia, Cameroon, Senegal, South Africa, Zambia and Zimbabwe) to investigate farmers' perceptions of and adaptations to climate change revealed that significant numbers of African farmers believe that temperatures have already increased, and that rainfall has not only declined, but also become less predictable. However, the study found that while farmers' perceptions about the climate in some countries (i.e., Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana and Zambia) correspond with climatic data records, farmers' observations in other countries do not correspond with meteorological data. Another study by Gbetibouo (2009) conducted with 794 smallhoder farmers in the Limpopo River Basin of South Africa to investigate perceptions and adaptations to climate change and variability concluded that the majority of the farmers believe that temperature has increased, that rainfall patterns have become unpredictable and also that the amount of rainfall has declined. Furthermore, the study established that the farmers' perceptions of climatic variability corresponded with meteorological data.

On the whole, this study and other studies investigating Africans' perceptions of climate change (e.g., Maddison 2006; Gbetibouo 2009; BBC WST 2010; Mweemba & Wu, 2010; Simelton et al., 2013; Vincent et al., 2013) provide strong evidence that the majority of Africans have perceived changes in climate. This is also understandable considering that a majority of Africans depend on rain-fed agriculture for their livelihoods. Indeed, most Africans' livelihoods depend principally on natural resources. As argued by Rajeck (1982), direct experiences of environmental issues or problems have strong influence on people's beliefs, perceptions and attitudes about the environment Rajecki (1982) and this also applies to the climate change issue.

5.4 Causes of changes in weather, climate and environment

In addition to being personally aware that the climate has changed, the majority of the respondents are also able to offer explanations why these changes in weather, climate and environment are taking place. Most lay people draw on their existing knowledge and beliefs to explain these changes. Content analysis of the responses to the question "Why do you think these changes are occurring? Please explain," produced the following broad categories of responses: deforestation; bad agricultural practices; pollution; depletion of the ozone layer; the will of God; apocalypse; overpopulation; and concentration of greenhouse gases in the atmosphere.

5.4.1 Frames of reference

Climate change is a complex scientific phenomenon that is difficult for most lay people to understand. This problem is compounded by a lack of reliable sources of accurate information about climate change. As a result, most people resort to using personal experience, pre-existing local knowledge, and beliefs and values in order to comprehend climate change.

Studies conducted in the USA by Kempton (1991), Bostrom et al. (1994), Kempton et al. (1995), and Reynolds et al. (2010) found that lay understanding of climate change issues is usually shaped by pre-existing local knowledge and beliefs, which become mental and cultural models (or frames of reference). These mental and cultural models that lay people use are quite different from the ones used by science experts.

This study also investigated what frames of reference Malawians use to understand climate change issues. Using content analysis, it is clear from the many open-ended responses that Malawians too use a variety of frames of reference to understand climate change. For instance, below are a few responses of the study participants to the question: “Why do you think these changes [changes in weather, climate and environment] are occurring? Please explain”:

> “Due to cutting down of trees, this may cause less rainfall and results into drought in some places.” [Female, age bracket 25-34, Accountant, Lilongwe city]

> “Overpopulation, which has put a burden on the environment. Industrial pollution by big companies.” [Female, age bracket 35-44, Animal science Technician, Lilongwe city]

> “Human activity, more especially industrial pollution. Cutting down of trees. People have cut a lot of trees which has affected rainfall patterns.” [Male, age bracket 25-34, Teacher, Lilongwe city]

> “Deforestation—trees (vegetation) help in precipitation, and depletion of ozone layer that leads to global warming.” [Male, age bracket 25-34, Teacher, Lilongwe city]

> “It's just time—biblical. Our carelessness in dealing with the environment” [Male, age bracket 45-54, Church Minister, Zomba city]

> “I think the biggest reason is deforestation. Like around here, being close to the mountain, I've seen trees being depleted. The other is also pollution.” [Male, age bracket 25-34, Teacher, Zomba city]

> “Air pollution (ii) Global warming (iii) Deforestation.” [Male, age bracket 45-54, Manager, Blantyre city]

"Deforestation especially in rural/ hilly areas. Emissions from industries that deplete the ozone layer. [Female, age bracket 35-44, Customs Officer, Mzuzu city]

"Wanton cutting down of trees. Excess emissions of gases from industrial companies, etc., which are now everywhere." [Male, age bracket 25-34, Banker, Blantyre city]

"It's nothing else but the will of God, who is creator of all things." [Male, over 55 years, Farmer, Salima]

"Cutting down of trees. Gases that are emitted from cars and factories are also causing the climate to change." [Male, over 55 years, Farmer, Fisherman, Nkhata-Bay]

"Environmental abuse e.g., careless cutting down of trees. (b) Overpopulation." [Male, age bracket 35-44, Farmer, Mulanje]

As can be noted from the above responses, study participants (regardless of their academic qualifications) draw on pre-existing local knowledge and beliefs to explain the causes of changes in weather, climate and environment. Some of the frames of reference Malawians use to understand the causes of climate change include 'deforestation,' 'the will of God,' 'apocalypse,' overpopulation,' 'air pollution,' and 'ozone depletion.' This is consistent with a qualitative study by BBC WST (2010) carried out in ten African countries which found that most Africans' understanding of climate change is influenced by five frames of reference, namely: 'emphasis on trees', 'the will of God,' 'ozone confusion,' 'air pollution' and 'localised heat'.

5.5 General awareness of climate change

When respondents were asked, "Have you heard about global climate change?", 268 respondents (92%) said "yes' and 22 (8%) said 'no'. Thus, comparatively, more respondents (99%) had personally experienced changes in weather, climate and environment than those who had just heard about climate change (92%) (see Figure 5.1). Nonetheless, these findings suggest that a majority of respondents (over 90%) are aware of changes in weather and climate.

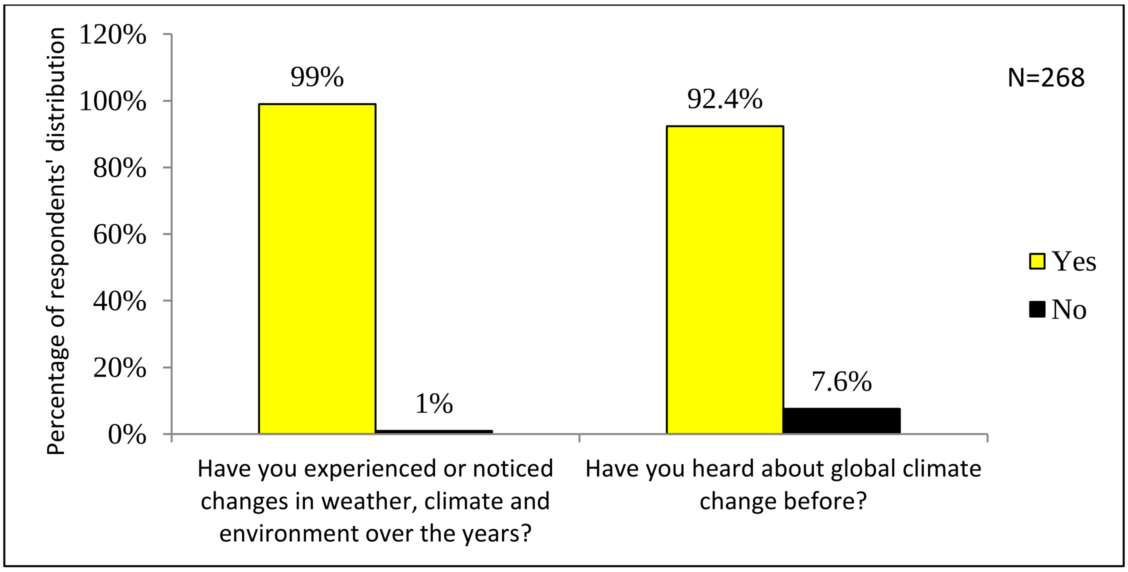

Figure 5.1: A graph comparing percentages of respondents who have experienced changes in weather, climate and environment versus those who have only heard about climate change

Figure 5.1 shows that there is a high level of awareness about climate change issues among the Malawian public. This implies that not only is there a high level of awareness about climate change in Europe, United States and other developed countries, but also in some African countries, including Malawi (see Lorenzoni & Pidgeon, 2006; Pugliese & Ray, 2009).

Although the findings show that there is generally a heightened awareness of climate change among members of the Malawi public, there are differences based on location (i.e., rural or urban), monthly household income, highest level of education and highest level of education in science-related subject.

Chi-square analysis indicates that significantly higher proportions of respondents from households whose monthly income is MK30, 000 or above (98.9% **), urban respondents (100% **), respondents who have either a secondary or tertiary education (99.2% ***), and respondents who have studied a science-related subject at secondary school (99% ***) have heard about climate change. These proportions are significantly higher than that of the total sample (92.4% **). As I will discuss in Section 5.7.2, higher-income earners, highly educated people, and urban residents (as opposed to rural inhabitants, less-educated and lower-income earners) have access to many more sources of information about climate change (which includes television, the Internet, newspapers, formal education and environmental groups), and as a consequence are more aware of climate change.

5.6 Sources of information about climate change

While the majority of respondents (92%) have heard about climate change, the avenues through which the climate change message was transmitted to them vary. It seems that Malawians have a wide range of sources of information about climate change including the media (i.e., television, radio, the Internet, and newspaper), institutions of learning (i.e., formal education), family and friends, churches and mosques, political rallies, environmental organisations, agricultural extension workers, non-governmental organisations, formal and informal forums (see Table 5.1).

Table 5.1: Frequency table with percentage distributions of multiple responses regarding sources of information about climate change in Malawi

Respondents' sources of information about climate change			
Source of information about climate change	**Responses**		**Percent of cases**
	N	Percent	
Television	102	9.9%	38.1%
Radio	247	24.0%	92.2%
The Internet	67	6.5%	25.0%
Newspaper	100	9.7%	37.3%
School/College/University	89	8.6%	33.2%
Family/Friends	148	14.4%	55.2%
Church/Mosque	91	8.8%	34.0%
Political rally	57	5.5%	21.3%
Environmental groups	81	7.9%	30.2%
Formal forums	6	.6%	2.2%
Informal forums	11	1.1%	4.1%
Agricultural Extension Workers	11	1.1%	4.1%
Non-governmental Organisations	5	.5%	1.9%
Personal Observation	12	1.2%	4.5%
Other	3	.3%	1.1%
Total	**1030**	**100.0%**	**384.3%**

Table 5.1 shows that the media i.e., television, radio, the Internet and newspaper, is the most

widely acknowledged source of information about climate change in Malawi with an aggregate of 51%. This finding is consistent with previous studies that show that the media is an important source of information about environmental issues, including climate change (Wilson, 2000; Whitmarsh, 2005; Sampei & Aoyagi-Usui, 2009). Nonetheless, within the broad category of media, the radio accounts for 24% of the various sources of information about climate change, followed by television (9.9%), newspaper (9.7%), and lastly, the Internet (6.5%).

Following the media, the study found that friends and family are the second most common source of secondary information about climate change in Malawi, accounting for 14.4%. Though this was an unexpected finding, it is consistent with studies conducted in Washington (Stamm, Clark & Reynolds Eblacas, 2000) and in southern England (Whitmarsh, 2005).

Other secondary sources of information include churches or mosques (8.8%); learning institutions (8.6%); environmental groups (7.9%), political rallies (5.5%), agricultural extension workers (1.1%); informal forums (1.1%); formal forums (0.6%); non-governmental organisations (0.5%); and other miscellaneous sources (0.3%).

Personal observation or experience was also mentioned as a source of information about climate change, and accounts for 1.2%. Considering that 'personal experience' was not included in the questionnaire as a response category, this finding cannot just be overlooked. As a matter of fact, this is consistent with previous studies that found that that many people use sensory experience to understand and explain changes in climate (BBC WST, 2010; Whitmarsh, 2005). The findings suggest then that there are two major sources of information about climate change, namely: direct (or sensory) and indirect (or secondary) sources.

5.7 Understanding of the concept "climate change"

Malawians have personally experienced changes in climate over the years and have also heard about climate change through secondary sources. But what do Malawians understand by the term 'climate change'? When 198 respondents who indicated they felt they had enough information about climate change were asked, "What do you understand 'climate change' to mean?" their responses varied. Content analysis of the open-ended responses to the question showed that common responses were: "Changes in average weather conditions over a long period of time"; "Changes in weather pattern"; "Changes in rainfall pattern, temperature and soil fertility (or crop yield)"; "Changes in temperature"; "Changes in weather/climate and surrounding environment"; "Changes in rainfall pattern"; "spread of sicknesses and diseases" and "Changes in timing of rainfall." For instance, the following five responses of five participants from five districts are examples of what Malawians generally understand by 'climate change':

> "Changes in weather patterns, rainfall patterns, in seasons (e.g., having either longer or shorter seasons than [previously] was the case), concentration of pollutants in the atmosphere leading to global warming." [Female, age bracket 45-45, Zomba city]

> "It means noticeable changes in terms of rainfall patterns, reduction of harvests, and spread of skin diseases." [Male, age bracket 18-24, Salima]

> "Differences in weather pattern between now and the past, say 20 years." [Female, age bracket 45-54, Ntcheu]

> "Climate change refers to changes in climate and weather patterns due to global warming which mainly results from increased emissions in chlorofluorocarbons into the atmosphere." [Male, age bracket 35-44, Mzuzu city]

> "Change in rainfall patterns and the time of planting." [Female, age bracket 25-34, Mulanje]

> "Erratic rainfall and very high temperatures. This was not the case in the past." [Male, age bracket 25-34, Salima]

It is clear from the responses that people's understanding of the concept 'climate change' is largely shaped by their experiences of changes in weather, climate and environment. Understandably, the responses seem to indicate that that the participants conflate the two terms "climate," and "weather". This finding is supported by previous research on public understanding of climate change (Kempton, 1991; BBC WST, 2010; Weber & Stern, 2011). Admittedly, a scientific understanding of the concept 'climate change' does elude many people, including those who are highly educated (Reynolds et al., 2010).

5.7.1 Personal observation/experience

Personal experience of daily weather changes can be a source of information for many people. A significant proportion of respondents who have never attended school or only have a primary school education (8.3%**) indicated "personal observation or experience" as a source of information about climate change. In contrast, no one who had attended secondary or tertiary education named this as a source.

Chi-square analysis indicates that a significant proportion of respondents who had not taken a science-related subject (8.7%**) at secondary or tertiary education levels, or a science-related subject at primary school (8.3%**) indicated "personal observation or experience" as a source of information about climate change.

It is said that experience is the best and powerful teacher; we all have learnt many things through personal experience. In the absence of other sources of information about climate change, many individuals whose economic livelihood depends on weather and climate events (i.e., farmers and fishers) use personal experience to detect changes in climate and are inclined to give recent events more weight than distant events, but they may also underestimate the future devastating effects of climate change (Leiserowitz & Broad, 2008; Spence et al., 2011; Li et al., 2011; Weber & Stern, 2011). This will be discussed further in Section 5.20.5.

5.7.2 Secondary sources of information about climate change

The study reveals that there are five major secondary sources of information about climate change in Malawi, namely: the media, family and/or friends, learning institutions, churches or mosques, and environmental groups. However, this does not mean that every Malawian has equal access to these sources. It is also important to note that access to certain sources of information has a bearing not only on awareness of climate change, but also on the accuracy of the information presented. In the sections that follow, I present the chi-square analysis results and their interpretation to provide more insights into the socio-demographic and geophysical variables that influence disparities with regard to awareness about climate change through secondary sources. These variables include: gender, age, location, religion, marital status, ethnicity, highest level of education, highest level of education in a science-related subject, monthly household income, region, and frequency of religious activities.

5.7.2.1 Media

The study found that the majority of respondents (51%) heard about climate change through the media i.e., radio, television, the Internet and newspapers, making media the most common secondary source of information about climate change in Malawi. Previous research similarly found that the mass media is an important source of information about climate change and has an enormous influence on beliefs, perceptions and attitudes about climate change (Weingart et al., 2000; Carvalho & Burgess, 2005; Whitmarsh, 2005). It is also important to note that regardless of whether it is accurate or not, media information has a profound influence on people's beliefs and perceptions about different issues (Krosnick & Kinder, 1990).

However, of the three forms of media, radio was the primary source of information about climate change accounting for 24% of the respondents, television 9.9%, newspaper 9.7%, and lastly, the Internet 6.5%. The chi-square analysis indicates that there is no difference among respondents when it comes to hearing about climate change through the radio.

Significantly more respondents who are single (never married) (92.9%***) than those who are married (36.2%***) and either divorced or widowed (22.7%***) heard about climate change through television. A significant higher proportion of respondents who never married (85.7%***) heard about climate change through the Internet. However compared to the total sample (25%), significantly smaller proportions of respondents who are married (23.3%***), divorced or widowed (4.5%***) heard about climate change through the Internet. Significantly more respondents who have never married (92.9%***) than those who are married (35.8%***) and divorced or widowed (18.2%***) heard about climate change through newspapers.

A further chi-square analysis indicates that of the 102 respondents who heard about climate change through television, significantly higher proportions of respondents aged 35-44 heard about climate change through television (53.2% **) and the Internet (32.9% **). However, significantly smaller proportions of those aged 55 and above had heard about climate change through television (21.2%**) and the Internet (3.0%**). There is no difference among the age groups when it comes to hearing about climate change through newspapers.

Significantly more urban respondents had heard about climate change through television (92.1% ***), newspapers (86.8%***) and the Internet (78.9%***). Thus, of the three forms of media, most urban respondents found out about climate change through television. However, in comparison to the total sample (25%), a significantly smaller proportion of rural respondents (3.6%***) had heard about climate change through the Internet. Of the three forms of media, more rural respondents had learnt about climate change through newspapers (34%) than television (31.4%) and the Internet (10.4%).

Monthly household income is a factor which seems to have an influence on accessing information about climate change. Unsurprisingly, significantly higher proportions of those who have a monthly household income of MK30, 000 or more had heard about climate change via television (82.3%***) and the Internet (68.5%***) compared to those who have a monthly household income of less than MK30, 000 (television, 15.3%***; and the Internet, 2.8%***).

Significantly more respondents who have either secondary or tertiary education had heard about climate change through television (66.1%***), the Internet (50.8%***) and newspapers (64.5%). As expected, a significant small proportion of those who have either never attended school or have only attended primary school had heard about climate change via the Internet (2.8%***).

Significantly more men had heard about climate change via the Internet (31.5%**) and newspapers (44.1%***). This is not very surprising considering that significantly more Malawian men (52.2%**) have a secondary or tertiary education than women (35.1%**). Chi-square analysis indicates that there is no difference between men and women when it comes to hearing about climate change through television.

Chi-square analysis indicates that ethnicity has an influence on awareness of climate change through the media. Significantly more respondents from the tribes of Ngoni (43.5%* and 34.8%**), Lomwe (60%* and 36%**), Tonga (50%*) and Tumbuka (46.5%* and 39.5%**) had heard about climate change through television and the Internet, respectively. There is no statistically significant difference among respondents based on ethnicity when it comes to hearing about climate change through newspaper.

Significantly more respondents from the Southern (47.6%**) and Northern (42.6%**) regions had heard about climate change through television. Furthermore, significantly more respondents from the Southern Region had heard about climate change through newspapers (45.2%*). However, when it comes to learning about climate change via the Internet, there was no difference among respondents based on region.

5.7.2.2 School/college/university

Formal education or institutions of learning are also an important source of information about climate change for both rural and urban areas. When place of residence is considered, a significantly higher proportion of urban respondents (69.7%***) than rural respondents (18.8%***) had heard about climate change through formal education.

A significantly higher proportion of men (41.7%**) than women (25.5%**) knew about climate change through institutions of learning. This finding is consistent with previous environmental psychological research which found that men usually have a more extensive environmental knowledge than women. At the same time women tend to be more concerned about environmental problems and are more willing to take action to address them (Lehmann 2002, cited in Kollmuss & Agyeman 2002).

Chi-square analysis indicates that significantly more respondents from households that get MK30, 000 or more per month (61.8%***) had heard about climate change through formal education than those whose households get less than MK30, 000 per month (18.2%***).

Unsurprisingly, significantly more respondents who had either a secondary or tertiary education (56.5%***) learnt about climate change through formal education. This is consistent with previous research that found that the more years of education a person has the more extensive is their knowledge of environmental issues (Kollmuss & Agyeman, 2002).

As anticipated, a higher proportion of respondents who had taken a science-related subject at secondary school (56.5%***) than those with a science-related subject at only primary school level (15.7%***) had found out about climate change through formal education.

Significantly higher proportions of both respondents who are single (71.4%**) and those who are married (33.8%**) learnt about climate change through formal education. Thus, marital status does not appear to be a significant factor here.

However, religion does appear to have an influence on knowledge of climate change issues. In comparison to the total sample (33.6%), more Christians (36.2%*) than Muslims (13.3%*) had learnt about climate change via formal education. This finding suggests that Christians in Malawi are more likely to hear about climate change through formal education.

How often a respondent attends religious activities seems to have an influence. Significantly higher proportions of respondents who attend religious activities a few times a year (45.2 %*) and those that attend religious activities weekly (36.1 %*) than those that attend religious activities more than weekly (20.6 %*) have heard about climate change through formal education. These findings suggest that the likelihood of an individual hearing about climate change through formal education is disproportionate to the number of times the individual attends religious activities. Thus, persons who engage in religious activities a few times a year are more likely to hear about climate change through formal education than those who participate in these activities more than weekly. This finding may also suggest that those that participate in religious activities more than weekly have low levels of education.

5.7.2.3 Friends and family

The results suggest that family members and friends are also an important source of climate change information. Family members and friends account for 14.4% of the sources of information about climate change, ranking second after radio (which accounts for 24% the total sources). Chi-square analysis shows that there is a relationship between the frequency of engaging in religious activities and awareness about climate change through friends and family members. Significantly higher proportions of respondents who engage in religious activities a few times a year (74.2%*) and those who do so more than weekly (61.8%*) are more likely to have heard about climate change through friends and family than those who do weekly (49.1%*).

5.7.2.4 Church or mosque

Place of residence influences whether a person obtains information about climate change issues through a church or mosque. In comparison to the total sample (34.0%), significantly more rural (40.1%**) than urban respondents (18.4%**) heard about climate change through a church or a mosque.

In addition, a significantly higher proportion of respondents who come from households with a monthly income of less than MK30, 000 (42%***) learnt about climate change through a church or a mosque. In comparison with the total sample (34.0%***), significantly fewer respondents from households with a monthly household income of MK30, 000 or more (18%***) learnt about climate change through a church or a mosque.

Significantly more respondents who had never attended school or only attended primary school (41.7%**) heard about climate change through a church or mosque, but far fewer who had a secondary or tertiary education (25.0%**) had heard about climate change through a church or a mosque.

In comparison to the total sample (34.4%), significantly more respondents who did not take a science-related subject at primary school (41.7%**) than those who had studied a science-related subject at secondary school (25.2%**) had heard about climate change through a church or a mosque.

5.7.2.5 Environmental groups

Several factors appear to influence the likelihood of Malawians learning about climate change via an environmental group. The chi-square analyses show that a higher proportion of urban respondents (60.5%***) than rural respondents (18.2%***), more men (37.0%*) than women (24.1%*); and more Christians (32.8%*) than Muslims (13.3%*) had heard about climate change through environmental groups.

There were also variations based on ethnic grouping, as significantly more proportions of respondents who are Lomwe (48.0%*), Tumbuka (44.2%*), and Ngoni (32.6%*) had heard about climate change through environmental groups. In comparison to the total sample (30.2%), the smallest proportion of respondents who had heard about climate change from environmental groups came from the Chewa ethnic group (19.1%*). This finding suggests that ethnicity does influence the likelihood of hearing about climate change through environmental groups.

A significant higher proportion of respondents from households that have a monthly household income of MK30, 000 or more (55%***) had heard about climate change through environmental groups than respondents from households whose monthly household income was below MK30, 000 (17.0%***).

The chi-square analysis of responses indicates that there is also a relationship between a higher level of education and hearing about climate change through environmental groups. Many more respondents who had either a secondary or tertiary education (46.0%***) fell into this group.

5.7.3 Summary: The relationship between background variables and respondents' major source of information about climate change

In Table 5.2 below I summarise the results presented in sections 5.6.2.1 to 5.6.2.5. Table 5.2 shows how the various background variables relate to respondents' major source of information about climate change.

Table 5.2: A summary of how background variables relate to respondents' major source of information about climate change

Background variable	Sub-group with significantly higher proportion of members who use a preferred source(s) of information about climate change	Major source of information about climate change (in brackets is the proportion of respondents within a sub-group who heard about climate change through the source)
Marital status	Never married	Newspaper (92.9%), the Internet (85.7%), television (92.9%) and formal education (71.4%)
Location	Rural	Church or mosque (40.1%)
	Urban	Newspaper (86.8%), the Internet (78.9%), television (92.1%), formal education (68.7%)
Age bracket	35-44	Television (53.2%), the Internet (32.9%)
	45-54	The Internet (30.6%)

Background variable	Sub-group with significantly higher proportion of members who use a preferred source(s) of information about climate change	Major source of information about climate change (in brackets is the proportion of respondents within a sub-group who heard about climate change through the source)
Gender	Male	The Internet (31.5%), newspaper (44.1%), formal education (41.7%), environmental groups (37%)
Monthly household income	<MK30, 000	Church or mosque (42%)
	MK30, 000 or more	Television (82.3), the Internet (68.5%), formal education (61.8), environmental groups (55.1%)
Highest level of education	Never attended school or only attended primary education	Church or mosque (41.7%)
	Attended either Secondary or Tertiary education	Newspaper (56.5%), the Internet (50.8%), television (66.1%), formal education (56.5%), environmental groups (46%)
Highest level of education in a science-related subject	Primary school	Church or mosque (41.7%)
Religion	Christian	Formal education (36.2%), environmental groups (32.8%)
Region	Southern	Television (47.6%), newspaper (45.2%)
	Northern	Television (42.6%)
Ethnicity	Lomwe	Television (60%), the Internet (36%), environmental group (48%),
	Ngoni	Television (43.5%), the Internet (34.8%), environmental group (32.6%)
	Tonga	Television (50%)
	Tumbuka	Environmental group (44.2%), the Internet (39.5%), television (46.5%)
Frequency of attendance to religious activities	More than weekly	Family and friends (61.8%)
	Weekly	Formal education (36.1%)
	Few times a year	Formal education (45.2%), family and friends (74.2%)

Table 5.2 shows that over 85% of respondents who have never been married heard about climate change through the media (i.e., newspaper, the Internet and television) and only 71%

of them learnt about climate change through formal education. The finding is consistent with analysis by Schreiner, Henriksen and Kierkeby Hansen (2005) who argue that many young people tend to use the mass media rather than formal education as their major source of information about climate change. It is also worthwhile to note that at least four major sources of respondents' information about climate are determined by each of the following background variables: marital status, location, gender, monthly household income, and highest level of education. Interestingly, churches or mosques are a major source of information about climate change for those who had never attended school or only had primary education, but not for those who frequently engage in religious activities. The latter (individuals who engage in religious activities weekly or more often) were more likely to have learnt about climate change through formal education and family/friends, respectively.

5.8 Trustworthiness of sources of information about climate change

People mostly obtain information from a source that they trust. In order to gauge how trustworthy respondents thought the various sources of information about climate change in Malawi were, they were asked, "How much would you trust the following sources of information about climate change?" Respondents were asked to rate this on a 5-point scale (where '1' means "Never trusted" , '2' "seldom trusted", '3' "sometimes trusted", '4' "Often trusted" and '5' "Almost always trusted"). The sources of information to be rated included the media, a family or friend, a village headman, a religious leader, a teacher, a politician, an environmental organisation, and a scientist.

Figure 5.2 depicts a ranking of trustworthiness of some sources of information about climate change, on the basis of their mean trust scores on a 5-point scale (represented by shaded/longer bars) and respective standard deviations (represented by white/shorter bars).

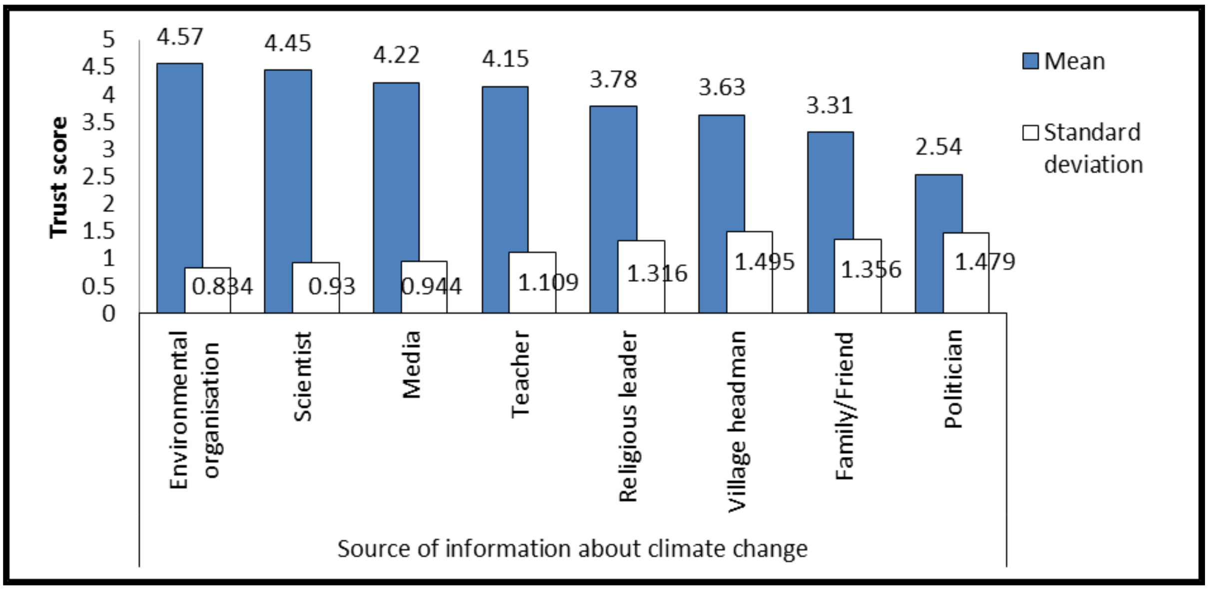

Figure 5.2: Ranking of trustworthiness of sources of information about climate change

Figure 5.2 above shows that the four most trusted sources of information about climate change are environmental organisations (4.57 out of 5), scientists (4.45 out of 5), media (4.22 out of 5) and teachers (4.15 out of 5). While this study ranks environmental organisations (4.57 out of 5) as the most trusted source of information about climate change , followed by scientists (4.45 out of 5), a study conducted in South England by Whitmarsh (2005) found that environmental groups there were ranked second (3.3 out of 4) after scientists (3.5 out of 4). Disregarding the rankings, these findings seem to suggest that environmental groups and scientists are considered to be the two most trusted sources of information about climate change by Malawians. Previous research indicates that environmental groups and scientists are generally considered to be highly trustworthy sources of information about environmental issues (Whitmarsh, 2005; Dietz, Dan & Shwom, 2007). Of all the sources of information about climate change, the least trusted is a politician. These findings suggest that anyone who wants to communicate the climate change message to Malawians should consider using scientists, environmental organisations for disseminating the message. However, scientists and environmental organisations have yet to seriously engage with the majority of Malawians on climate change issues. But the question that needs to be answered is: What factors influence the trustworthiness of a source of information about climate change in Malawi?

5.8.1 Relationship between trustworthiness of a source of information about climate change and socio-demographics

Some studies have established that there is a relationship between trust in sources of information about climate change and people's perceptions and support for climate change policies (Fortner et al., 2000). Trust in a source of information about climate change may be influenced by several factors. This study has found that trust in sources of information can also be influenced by some background variables and sources of information about climate change. The subsequent sections discuss these findings.

5.8.1.1 Village headman

In Malawi, village heads have a great deal of influence in rural areas compared to urban areas. They are highly respected and have unrivalled access to rural communities. Thus, village heads are an important source of information for most people in rural areas. Chi-square analysis indicates that a significant proportion of rural respondents (82.2%***) trust their village headmen as a source of information about climate change. With the highest Pearson's chi-square value of 40.573, village headmen are the most trusted of all the sources of information among rural respondents. A significantly smaller proportion of urban respondents (44.0%***) trust village headmen as a source of information about climate change. This finding is consistent with previous research that emphasises that local leaders including village heads "have unrivalled access to communities and are respected and trusted sources of information", although they are also among the least informed about climate change (BBC WST, 2010: 15).

Unsurprisingly, a significant higher proportion of respondents from households that have a monthly household income of less than MK30, 000 (82.7%***) than those from households with a monthly income of MK30, 000 or more (48.0%***) trust village headmen as a source of information about climate change.

The highest level of education obtained by respondents influences their trust in a village headman as a source of information about climate change. A significantly higher proportion of respondents who have either never attended school or only attended primary school (83.0%***) were more likely to trust a village headman as a source of information about climate change than respondents with either a secondary or tertiary education (58.1%***).

A somewhat interesting finding is that significant higher proportions of respondents who are married (73.6%*) and divorced/widowed (76.0%*) also consider village headmen as a trustworthy sources of information about climate change, whereas only 42.9% of single respondents do. The finding is consistent with another finding of the study showing that the majority of single respondents prefer the newspaper, the Internet, television and formal education as their major sources of information about climate change.

5.8.1.2 Teachers

Teachers are considered a trusted source of climate change information by the majority of Malawians. However, this differs between rural and urban respondents. A significantly higher proportion of urban respondents (97.4%*) trust teachers as a source of information about climate change. Compared to the total sample (91.9%), a significantly smaller proportion of rural respondents (90.0%*) consider a teacher as a trustworthy source of information about climate change.

Education has influence on trust in a teacher as a source of information about climate change. Chi-square analysis indicates that a significant higher proportion of respondents with a secondary or tertiary education (96.0%*) considered teachers a trustworthy source than those who never attended school or only attended primary school (88.8%*). Note that the proportion of the total sample that trusted teachers as a source of information about climate change is 91.9%.

Significant higher proportions of respondents from the Central (96.9%*) and Northern (94.7%*) regions trusted teachers as a source of information. However, a significant smaller proportion of respondents from the Southern Region (87.0%*) consider a teacher as a trustworthy source of information about climate change.

Significantly respondents who hold liberal political beliefs (95.2%**) or are politically neutral (97.3%**) were more likely to trust teachers as a source of information about climate change than those who hold conservative political views (82.4%**).

5.8.1.3 Politician

The study found that the majority of respondents do not consider politicians as a trustworthy source of information about climate change. This notwithstanding, the study found that for respondents who did trust politicians, there were differences among them based on age. Significantly higher proportions of respondents over the age of 35 (35-44 [56.1%*] and those aged 45 and older [46.2%*]) trusted politicians as a source of information about climate change. However, compared to the total sample (45%), a significantly smaller proportion of respondents aged 18-34 (36.2%*) also consider politicians a trustworthy source of information about climate change.

What explanation can be offered to account for these disparities? Further analysis shows that 57 respondents indicated that they heard about climate change through a political rally. Of these, 20 respondents (representing 35%) were aged between 18 and 34 years, and the remaining 37 (representing 65%) were 35 years and older. Statistically, the difference in numbers between the two groups is significant. Arguably, trustworthiness of a source of information about climate change is to a large extent determined by where one gets such information. In this regard, the majority of individuals who are aged 35 and above are likely to consider politicians a trustworthy source of information about climate change. This explanation may suffice. However, more research on the relationship between age and trust in various sources of information about climate change is warranted.

5.8.2 Relationship between trustworthiness of a source of information about climate change and source of information about climate change

The study has also established that there is a relationship between trustworthiness of a source of information and source of information about climate change. Analysis to establish the relationships reveal that people trust sources of information about climate change based on their accessibility. That is to say, a person cannot trust a source of information about climate change if they have never heard anything regarding climate change issue from the said source. The sections below discuss the findings of chi-square analyses performed to establish the relationship between trustworthiness of a source of information about climate change and the various sources of information about climate change.

5.8.2.1 Village headmen

Significantly more respondents who have learnt about climate change through television (55.4%***), the Internet (50%***), newspaper (57.6%***), formal education (60.2%**), family and friends (78.2%*) and environmental organisations (59.3%**) do trust village headmen as a source of information about climate change. These findings are interesting because though village headmen are trusted as a source of information about climate change, ironically they are the least knowledgeable about climate change issue. The BBC WST (2010) study found that in most African countries local leaders including village headmen have unrivalled access to communities, yet they display little understanding of climate change.

5.8.2.2 Teacher

Significantly higher proportions of respondents who have learnt about climate change through the Internet (98.5%*), newspaper (97%*), formal education (97.8%*) and environmental groups (97.5%*) do trust a teacher as a source of information about climate change. Note that the percentages in all the sub-groups are quite high i.e., over 95%.

5.8.2.3 Family and friends

Significantly more respondents who have heard about climate change through family or friends (81.1%***) and formal education (80.5%*) trust family and friends as a source of information about climate change. Also note that the proportions in these two sub-groups are above 80%.

5.8.2.4 Religious leader

A significant proportion of respondents who have heard about climate change through family and friends (87.8%**) trust a religious leader as a source of information about climate change.

5.8.2.5 Environmental organisation

A significant proportion of respondents who have heard about climate change through family and friends (98%*) trust environmental organisations as source of information about climate change.

5.8.2.6 Politicians

A significant proportion of respondents who have heard about climate change through a political rally (58.9%*) trust politicians as source of information about climate change.

5.8.3 Summary: Relationship between background variables and trustworthiness of information sources

In Table 5.3 below I summarise what has been discussed in sections 5.8.1 to 5.8.2. Table 5.3 indicates how the various background variables relate to the most trusted sources of information about climate change.

Table 5.3: A summary of how background variables relate to trustworthiness of sources of information about climate change

Background variable	Sub-group with significantly higher proportion of members who trust a preferred source of information about climate change (in brackets is the proportion of respondents within a sub-group who trust the source)	The most trusted of source of information about climate change
Location	Rural (82.2%)	Village headman
	Urban (97.4%)	Teacher
Monthly household income	<MK30 000 (82.7%)	Village headman
Age bracket	35-44 (56.1%)	Politician
	45 and older (46.0%)	Politician
Marital status	Married (73.6%)	Village headman
	Divorced or widowed (76.0%)	Village headman
Highest level of education	Never attended school or only attended primary school (83.0%)	Village headman
	Secondary or tertiary education (96.0%)	Teacher
Region	Central (96.9%)	Teacher
	Northern (94.7%)	Teacher
Political beliefs	Liberal (95.2%)	Teacher
	Neutral (97.3%)	Teacher
Source of information about climate change	The Internet (98.5%); newspaper (97%); formal education (97.8%); environmental organisation (97.5%)	Teacher
	The Internet (50%); television (55.4%); newspaper (57.6%); formal education (60.2%); family and friends (78.2%); environmental organisations (59.3%)	Village headman
	Family and friends (87.8%)	Religious leader
	Family and friends (81.1%); formal education (80.5%)	Family and friends
	Family and friends (98%)	Environmental organisations
	Political rally (58.9%)	Politician

Table 5.3 shows that a majority of urban residents and educated people consider teachers as the most trustworthy source of information about climate change. This is an interesting because the analysis also found that the urban and educated respondents had also heard about climate change through the media. Obviously, they do not consider the media one of the most trustworthy sources of climate change information. Other sub-groups who regard teachers as the most trustworthy source of information about climate change are inhabitants from the Central and Northern regions, people who hold neither liberal nor conservative political beliefs, individuals whose sources of climate change information include the Internet, newspaper, formal education and environmental groups village headmen are considered the most trustworthy sources of information about climate change for rural dwellers; married, divorced and widowed people; individuals whose monthly income does not exceed Mk30 000; those who have never attended school or only attended primary school, people whose source of information about climate change include the Internet, newspaper, television, formal education, family/friends and environmental groups. Unsurprisingly, individuals who have heard about climate change through a political rally trust politicians as a source of information about climate change. Other sub-groups who trust politicians as source of information about climate change are those aged 35 years and older. Family and friends are the most trusted source of information about climate change among those whose sources of information about climate change are formal education and family/friends. Religious leaders are trusted among those whose information about climate change are family members or friends. Environmental groups are considered the most trustworthy source of information among people who hear about climate change through family and friends.

5.9 Self-reported level of knowledge about climate change

It is difficult to measure people’s level of literacy about climate change. However, through their self-reported level of knowledge or understanding about climate change we can gauge how much knowledge people have about the issue. Figure 5.3 below is a bar chart depicting the respondents’ distribution in respect to their self-reported level of knowledge.

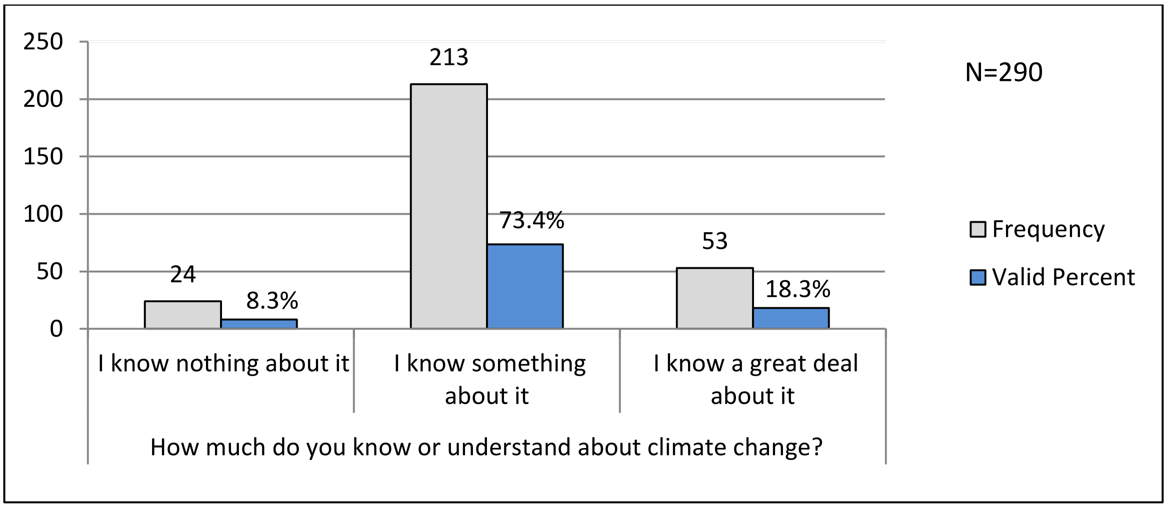

Figure 5.3: The distribution of respondents' self-reported level of knowledge about climate change

When asked, "How much do you know or understand about climate change?" 213 respondents (73.4%) said they knew something about climate change, 52 (18.3%) said they knew a great deal about it and 24 (8.3%) did not know anything about it. This means that at least 92% of the respondents know something about climate change or a great deal about climate change. These findings validate the data because the percentage of those who said they did not know anythging about climate change (i.e., 8.3%) is consistent with the percentage of those who had never heard about climate change (i.e., 9%). Of course, self-reported levels of knowledge or understanding about climate change may not necessarily translate to actual knowledge about climate change. Actual knowledge or literacy about climate change to some extent can be measured when individuals are asked questions about climate change.

5.10 Self-reported adequacy of information about climate change

When asked, "Do you feel you have enough information on climate climate change to have an opinion about it?" 70.7% said 'yes' and 29.3% said 'no'. This question was used to filter respondents into two subrgoups: those who said 'yes' were asked to answer questions 9 to 15, and those who said 'no' would omit these questions. Only 198 out of 280 answered questions 9 to 15.

Is there a relationship between self-reported level of knowledge about climate change and self-reported adequacy of information about climate change? Would respondents who say they knew a lot about climate change feel they have enough information about climate change to have an opinion about it? Chi-square of responses indicate that there is a relationship between these two variables.

5.10.1 The relationship between self-reported adequacy of information about climate change and self-reported level of knowledge about climate change

Chi-square analysis was performed to establish whether there is a relationship between self-reported level of knowledge about climate change and self-reported adequacy of information about climate change. When asked, “Do you feel you have enough information on climate change to have an opinion about it?”, a significantly higher proportion of respondents who agreed that they knew a great deal about climate change (82.4%***) also felt that they had enough information on climate change to have an opinion about it. Furthermore, significantly more respondents who knew something about climate change (74.3%***) felt they had enough information on climate change to have an opinion about it. Unsurprisingly, none of the respondents who knew nothing about climate change felt they had enough information on climate change to have an opinion about it.

5.10.2 Relationship between self-reported adequacy of information about climate change and source of information about climate change

People’s feeling of adequacy with regard to their knowledge of climate change issues is to a large extent determined by their sources of information. As a matter of fact, the source of information is as important as the content of the message. Chi-square analysis of the responses was performed to establish whether there is a relationship between self-reported adequacy of information about climate change and source of information about climate change. The analysis results show that when it comes to self-reported adequacy of information about climate change, there are differences among respondents, based on which source of information they used.

Significantly more respondents who received their climate change information from environmental groups (84.4%**) felt they had enough information about climate change to have an opinion about it than those who were informed via other sources (68.5%).

Similarly, a significantly higher proportion of respondents who learnt about climate change via formal education i.e., school, college or university (84.7%**) felt that they had enough information about climate change to have an opinion about it than those who used different sources (67.6%**).

5.10.3 Relationship between self-reported adequacy of information about climate change and socio-demographic characteristics

Some studies have found that demographic characteristics have an influence on self-reported adequacy of information about climate change. The study tried to establish whether demographic characteristics do indeed determine people's self-reported adequacy of information of the topic. Upon performing chi-square analysis of responses, the results indicate that this is the case for a significantly high proportion of respondents who have the following socio-demographic characteristics:

- urban respondents (81.1%*) (compared with 67.0%* of rural respondents);
- respondents who have either attended secondary or tertiary education (82.5%***) (versus those who have never attended school or only attended primary school - 61.9%***);
- men (78.8%**) (rather than women - 63.5%**);
- respondents from the Northern region (86.2%**) (Southern - 63.8%**, and Central regions - 70.5%**);
- respondents from the following ethnic groups: Ngoni (71.7%*), Tumbuka (88.4%*), Tonga (76.2%*) and Yao (73.0%*);
- respondents from households with a monthly household income of MK30, 000 or above every month (80.7%*) (rather than those with a monthly income of less than MK30, 000 - 66.1%*);
- respondents who are single (never married) (76.9%**) (versus those who are married - 73.3%**, or either divorced or widowed - 41.7%**);
- respondents from Blantyre (80.0%*), Lilongwe (71.1%*), Kasungu (73.7%*), Salima (80.0%*), Nkhata-Bay (80.0%*) and Mzimba (89.5%*);
- respondents who took a science-related subject at secondary school (82.1%***) (as against those who have never taken a science-related subject or only done so at primary school - 61.9%***).

Some of these findings are consistent with previous research. For instance, Kollmuss and Agyeman (2002) cite Fliegenschnee and Schelakovsky (1998), and Lehmann (1999) who found that gender and years of education influence environmental beliefs and attitudes. They also found that men have more extensive knowledge about environmental issues than women, and the longer a person's education is, the more extensive is their environmental knowledge.

5.11 Belief that climate change is happening

It is one thing to acknowledge having personally experienced or noticed changes in weather, climate and environment over time, and another to believe that climate change is really happening. As I discussed in Section 5.3, Malawians have experienced a sufficient number of changes in their weather, climate and environment over the years to potentially convince people to believe that climate change is indeed happening. However, to establish whether Malawians believe that climate change is happening, respondents were asked to agree or disagree with two statements.

5.11.1 Perceived temperature variations influence belief that climate change is happening

When respondents were asked the extent to which they would agree or disagree with the statement “Changes in daily temperature of this area make me believe that climate change is happening,” 96% agreed, 2% disagreed, and 2% expressed no opinion.

This finding provides more evidence that Malawians have personally experienced changes in their local weather. These changes in their local weather have convinced them that climate change is happening. This finding is consistent with previous studies that found that there is a relationship between personal experience of local weather patterns (especially changes in weather and precipitation) and the belief that climate change is taking place (Krosnick et al., 2006; Li et al., 2011; Egan & Mullin, 2012; Capstick & Pidgeon, 2014). This belief may also influence people’s willingness to support initiatives aimed at addressing climate change. The study found that 99.3% of respondents who agreed with the above statement would be willing to support the implementation of a national climate change policy once it has been developed.

5.11.2 Experience of some catastrophes influence belief that climate change is happening

In some parts of Malawi (for instance, Lilongwe, Zomba and Chikhwawa) people have experience catastrophes, for example, floods in their lifetime. Thus, when respondents were asked the extent to which they would agree or disagree with the statement, “Some catastrophes such as floods and tsunamis make me believe that climate change is happening”, 90% agreed, 7% disagreed and 3% expressed no opinion.

This finding is consistent with previous research on the relationship between physical vulnerability and belief that climate change is happening (Zahran et al., 2006; Brody et al., 2008). Catatrophic events such as floods and tsunamis also have the potential to influence people’s willingness to support climate change policies. In addition, 99.6% of those who agreed with the statement were willing to support the implementation of a national climate change policy once it is developed. However, this result is not statistically significant.

5.12 Certainty/uncertainty about climate change

Public uncertainty about climate change is of interest for some researchers. Empirical studies conducted in UK and USA found that some people are uncertain as to whether climate change ‘really’ exists, is caused by human activities or will have a negative impact on their wellbeing (Petty & Krosnick, 1995; Poortinga et al., 2011). Thus it is possible to believe that climate change is happening and another to be certain that climate change is indeed happening. Or, one can believe that climate change is happening but uncertain what its effects will be. To ascertain whether Malawians believe with certainty that climate change is happening, respondents were asked the extent to which they would agree or disagree with the statement: “I am uncertain that climate change is happening”. Their responses indicate that 70% disagreed, 24% agreed and 6% were undecided. This is an interesting finding; while 99% of the respondents had experienced or noticed changes in weather, climate and environment over the years, and 90% believed that climate change is happening, only 70% were certain that climate change is happening.

Chi-square analysis indicates that a significantly higher proportion of respondents who had either a secondary or tertiary education (80% **) were certain that climate change was taking place than those who had either never attended school or only attended on primary school

(63%**). Significantly more respondents in the latter category (30.9% **) said that they were uncertain that climate change is happening than respondents with more education (14.4% **) These findings suggest that individuals who are better educated are likely to be certain that climate change is happening, which is are consistent with a study by Krosnick and colleagues (2006) who found that certainty about climate change is a function of knowledge and prior thought.

5.13 Certainty/uncertainty about the causes of climate change

When asked, "Thinking about the causes of climate change, which, if any, of the following best describes your opinion? (a list of seven response categories was provided), all 198 respondents who were supposed to answer this question (see question 8 of the questionnaire survey directing respondents to this particular question item) gave their responses regarding their understanding of the causes of climate. Unsurprisingly, these respondents hold diverse of views on the causes of climate change (see Table 5.4).

Table 5.4: Frequencies for multiple responses on causes of climate change from respondents who feel they have enough information on climate change to have an opinion about it

Respondents' understanding of the causes of climate change (N=198)			
Cause of climate change	**Multiple Responses**		**Percent of Cases**
	N	Percent	
Entirely natural processes	35	13.1%	17.7%
Mostly natural processes	16	6.0%	8.1%
Natural processes and human activities	92	34.3%	46.5%
Mostly human activities	69	25.7%	34.8%
Entirely human activity	53	19.8%	26.8%
I think there is no such thing as entirely human activity	2	.7%	1.0%
Don't know	1	.4%	.5%
Total	**268**	**100.0%**	**135.4%**

Table 5.4 shows that 198 respondents provided 268 responses (an average of 1.35 responses per respondent). Furthermore, there were a considerable number of responses (92) for "natural processes and human activities" and 2 responses for "I think there is no such thing as entirely human activity". Almost 20% attributed climate change to "Entirely human activity". Only one respondent said "Don't know". This means that if the causes of climate change are to be

ranked, this would be the order (in descending order): natural processes and human activities (34.3% of the total responses); mostly human activities (25.7%); entirely human activity (19.8%); entirely natural processes (13.1%) and mostly natural processes (6%).

When respondents were later asked the extent to which they agreed with the statement "The causes of climate change are not known", 56% disagreed, 40% agreed and 4% expressed no opinion. In other words, 56% of respondents were certain that the causes of climate change are known, while 40% were of the view that the causes of climate change are not known. What accounts for the certainty/uncertainty about the causes of climate change? Chi-square analyses show that when it comes to certainty about causes of climate change, there are differences in responses based on socio-demographic characteristics and source of information about climate change.

Significantly more rural respondents (52.3%***), women (48.1%*), Muslims (58.8%*), respondents who had never attended school or only had primary school education (60.0%***) and who come from households with a monthly income of less than MK30, 000 (55.3%***) indicated that they believed that the causes of climate change were not known.

When it comes to sources of information about climate change, significantly higher proportions of respondents who had not heard about climate change through television (50.0%***), the Internet (47.8%***), newspaper (50.0%***), formal education (48.6%***) and environmental groups (48.1%***) agreed that the causes of climate change were not known. These findings are consistent with other findings of the study discussed earlier in Section 5.6.2.1.

5.13.1 Climate change is caused by "natural processes and human activities"

The study found that a considerable majority of the respondents believed that climate change is caused by "natural processes and human activities." This is probably what is believed to be the greatest cause of climate change in Malawi. It accounts for 34.3% of the causes of climate change. Chi-square analysis indicates that when it comes to belief in the causes of climate change, there are differences among the respondents based on the source of their information. There is a relationship between the belief that climate change is caused by natural processes and human activities and the following sources of information about climate change: television, the Internet, newspaper, and school/college/university. Certainly, the source of information about climate change has an influence on beliefs, perceptions and attitudes regarding climate change.

Of the 54 respondents who learnt about climate change through the Internet, significantly more respondents (61.1%**) believe that climate change is caused by natural processes and human activities. However, a significantly smaller proportion of respondents whose source of information about climate change is not the Internet (40.1%**) believe that climate change is caused by natural processes and human activities. This finding suggests that people who hear about climate change through the Internet are likely to believe that climate change is caused by natural processes and human activities. This finding was confirmed by responses to the question: "Why do you think these changes [changes experienced in weather, climate and environment over the years] are occurring? Please explain." Some of the respondents who heard about climate change through the Internet and believe that climate change is caused by natural processes and human activities gave the following responses:

> **Respondent A:** "A combination of naturally occurring geographical activities and human activities that have been detrimental to the environment e.g., deforestation and carbon emissions." [Male, middle-aged, Master's degree holder, Zomba city]

> **Respondent B:** "A combination of natural and man-made factors must somehow contribute to this." [Male, middle-aged, Doctorate degree holder, Zomba city]

> **Respondent C:** "I think that these changes are occurring because of such things as: deforestation, emission of carbon dioxide into the atmosphere, and natural causes." [Male, middle-aged, Master's degree holder, Mzuzu city]

Note that the three respondents allude to natural processes and human activities as causes of climate change. Also note the high academic qualifications that each of respondents possesses. This suggests that a higher level of education does influence the belief that climate change is caused by a combination of natural processes and human activities.

The following confirms that there is a relationship between the belief that climate change is caused by natural processes and human activities and learning about climate change through formal education. Of the 72 respondents who heard about climate change through formal education, significantly more respondents (58.3%**) believe that climate change is caused by natural processes and human activities. A significantly smaller proportion of respondents who did not learn about climate change through formal education (38.7%**) believe that climate change is caused by natural processes and human activities. This finding suggests that an individual who learns about climate change through formal education is more inclined to believe that climate change is caused by natural processes and human activities. This finding is also supported by qualitative data. Respondents A and C cited in the above paragraph knew about climate change not only from the Internet, television and newspaper but also through their formal education.

Chi-square analysis indicates that of the 78 respondents who said they heard about climate change through television, a significantly higher proportion (57.7%**) believe that climate change is caused by “natural processes and human activities”. However, a significantly smaller proportion of respondents whose source of information about climate change was not television (38.1%**) believe that climate change is caused by natural processes and human activities. This finding suggests that individuals who hear about climate change through television are more likely to believe that climate change is caused by natural processes and human activities. This is also supported by the qualitative data obtained during the interview survey. For instance, the three respondents quoted above (Respondents A, B and C) had also heard about climate change through television.

Chi-square analysis indicates that of the 76 respondents who have heard about climate change through a newspaper, significantly more (60.5%**) believe that climate change is caused by natural processes and human activities. A smaller proportion of respondents who had not heard about climate change through newspapers (36.5%**) believe that climate change is caused by natural processes and human activities. This finding is supported by qualitative data. For instance, Respondents A and C has also heard about climate change through a newspaper.

5.13.1.1 Relationship between belief that climate change is largely anthropogenic and that climate change and its impact is not the will of God

An analysis of what Malawians believe the causes of climate change are reveals that the majority of the respondents (214 responses, representing almost 80%) implicate human beings. However, some respondents also simultaneously believe that climate change is the will of God.

The majority of Malawians believe that climate change is largely anthropogenic, which is in line with scientific facts about the causes of climate change. Scientists assert that climate change is largely anthropogenic, meaning that human activities have caused climate change. Malawians seem to understand this fact on the basis of what they have seen happening in their local communities. When asked the extent to which respondents agree or disagree with the statement “Human beings are to a larger extent responsible for climate change,” 85% agreed, 13% disagreed, and 2% expressed no opinion.

While the majority of respondents believe that climate change is largely anthropogenic, others believe that climate change and its effects are the will of God. However, these two beliefs are not mutually exclusive. When asked the extent to which they agreed or disagreed with the statement “Climate change and its impact is the will of God”, 54% agreed, 38% disagreed and 8% were undecided.

Analysis to establish whether there is a relationship between the belief that climate change is largely anthropogenic and the belief that climate change and its impact is not the will of God indicates that significantly more respondents who did not believe that “climate change and its impact is the will of God” (97.3%***) agreed that “human beings are to a larger extent responsible for climate change”. This finding suggests that individuals who believe that climate change and its effects are the will of God are less likely to believe that human beings are largely responsible for climate change.

5.13.2 Climate change is caused by “mostly human activities”

The study found that 25.7% of the respondents said that climate change is caused by “mostly human activities”. When ranked, this is the second major cause of climate change. Further analysis indicates that there is a relationship between the belief that climate change is caused by “mostly human activities” and hearing about climate change through a political rally.

Chi-square analysis indicates that a significantly higher proportion (48.8%*) of the 43 respondents who heard about climate change through a political rally said that climate change is caused by mostly human activities. However, a significantly smaller proportion of respondents whose source of information about climate change is not a political rally (28.4%*) believe that climate change is caused by mostly human activities. This finding suggests that individuals who hear about climate change through a political rally are more likely to believe that climate change is caused by mostly human activities. This is supported by following responses to the question: "Why do you think these changes [changes experienced in weather, climate and environment over the years] are occurring? Please explain." (These responses are from respondents who heard about climate change through a political rally and also said that climate change is caused by mostly human activities.):

> **Respondent K:** "It is happening due to careless cutting down of trees in order for people to produce charcoal to sell and get money. Industrial activities that result in air pollution." [Male, young adult, Zomba city]

> **Respondent L**: "Due to pollution: the ozone layer is depleted as a result, the ice in the polar regions melts resulting into flooding." [Female, middle-aged, Blantyre city]

> **Respondent M:** "I think it's because indigenous trees are finished; they have been cut." [Female, young adult, Salima]

> **Respondent N:** "Cutting down of trees. It is natural change of climate." [Male, over 55 years old, Salima]

There is one common theme running through all these responses, that is, human activities have caused climate change. It seems that respondents believe that human activities that include deforestation have caused climate change. Whether these human activities have indeed caused climate change will be discussed later. However, it may suffice to say that there is scientific evidence suggesting that climate change is largely anthropogenic.

5.13.3 Climate change is caused by "entirely human activity"

Some Malawians believe that climate change is caused by entirely human activity and 19.8% of the respondents in this study said that climate change is caused by "mostly human activities". When the causes are ranked, "mostly human activities" comes third. Chi-square analysis indicates that there is a relationship between the belief that climate change is caused by "entirely human activity" and hearing about climate change through a family member and/or friend.

Of the 48 respondents who said that climate change is caused entirely by human activity, a significantly higher proportion (33.0%**) heard about climate change from a family member or friend. (In contrast, a significantly smaller proportion of respondents who have not heard about climate change through a family member or friend (14.6%**) also said that climate change is caused by entirely human activity.) This suggests that people who heard about climate change from a family member or a friend are more likely to believe that climate change is caused by entirely human activity.

Further analysis indicates that there is a relationship between people's sources of information about climate change and belief that “the concentration of greenhouse gases in the atmosphere leads to changes in climate”. Chi-square analysis indicates that a significantly higher proportion of respondents (89.2%**) who used family members or friends as a source agreed with the statement “The concentration of greenhouse gases in the atmosphere leads to changes in climate”. However, compared to the total sample (83.6%), fewer respondents who used other sources (76.7%**) agreed with this statement. This means that individuals who hear about climate change from a family member or friend are more likely to believe simultaneously that climate change is caused by “entirely human activity” and an increase in greenhouse gases.

The finding is supported by qualitative data. For instance, when asked “Why do you think these changes [changes in weather, climate, and environment] are occurring? Please explain,” a middle-aged male respondent from Lilongwe city who learnt about climate change through a family member or friend and also believes that climate change is caused by entirely human activity gave the following explanation:

> “Concentration of greenhouse gases. Deforestation: careless cutting down of trees.” [Male, middle-aged, Master’s degree holder, Farmer and Logistics Officer, Lilongwe city]

The above response makes reference to “concentration of greenhouse gases” and “deforestation” as causes of changes in weather, climate, and environment. This is not far from the scientific truth; human activities have largely contributed to climate change resulting in greenhouse gases being emitted into the atmosphere.

Clearly, there is no marked difference between explanations by respondents who heard about climate change through a political rally and believe that climate change is caused by mostly human activities and respondents who heard about climate change through a family member or friend and also believe that climate change is caused by entirely human activity. This suggests that there could be a relationship between the belief that climate change is caused by "mostly human activities" and belief that climate change is caused by "entirely human activity." Although semantically, the two phrases—"mostly human activities" and "entirely human activity"—mean two different things, the respondents appear to have considered these two response categories related, and selected both in response to question 10.

Belief that climate change is caused by "entirely human activity" is also related to hearing about climate change through a church or a mosque. Of the 48 respondents who said that climate change is caused by "entirely human activity," a significantly higher proportion (41.4%***) heard about climate change through a mosque or a church. However, a smaller significant proportion of respondents who have not heard about climate change through a church or mosque (15.7%***) believe that climate change is caused by "entirely human activity". This finding suggests that people who hear about climate change through a mosque or a church are likely to believe that climate change is caused by "entirely human activity."

This is supported by qualitative data:

> "Careless cutting down of trees." [Male, middle-aged, Ntcheu]

> "It is because we are cutting down trees carelessly." [Male, young adult, Salima]

> "I think it's because indigenous trees are finished; they have been cut." [Female, young adult, Salima]

Note that the last response was given by respondent who also heard about climate change through a political rally and believes that climate change is caused by mostly human activities (Respondent M) (refer to Section 5.13.2). Note that there is no marked difference between the above three responses and those given by respondents who learnt about climate change through a political rally and also believe that climate change is caused by mostly human activities.

There is a relationship between hearing about climate change through a political rally and the belief that climate change is caused by entirely human activity. Of the 43 respondents who learnt about climate change through a political rally, a significantly higher proportion of respondents (51.2%***) believe that climate change is caused by "entirely human activity." Compared to the total sample, a significantly smaller proportion of those who have not heard about climate change through a political rally (17.6%***) believe that climate change is caused by entirely human activity. This finding suggests that individuals who accessed information about climate change through a political rally are more likely to believe that climate change is caused by entirely human activity than those who heard via other sources. The finding is supported by qualitative data cited below:

> "It is happening due to careless cutting down of trees in order for people to produce charcoal to sell and get money. Industrial activities that result in air pollution." [Male, young adult, Zomba city]

> "I think it's because indigenous trees are finished; they have been cut." [Female, young adult, Salima]

5.13.4 Climate change is caused by "entirely natural processes"

Some respondents (13.1%) believe that climate change is a result of "entirely natural processes". This study ranks "entirely natural processes" as the fourth cause of climate change in Malawi. However, not every Malawian respondent who heard about climate change believed that climate change is caused by entirely natural processes. Chi-square analysis indicates that there is a relationship between the belief that climate change is caused by "entirely natural process" and hearing about climate change through the Internet and newspaper.

Chi-square analysis indicates that when it comes to the belief that climate change is caused by entirely natural processes, there is a difference among respondents depending on whether an individual heard about climate change through the Internet or not. Significantly more respondents who believe that climate change is caused by entirely natural processes (90.3%*) have not heard about climate change through the Internet. However, compared to the total sample (16.2%), a significantly smaller proportion of respondents who have heard about climate change through the Internet (9.7%*) believe that climate change is caused by entirely natural processes. This means that individuals who hear about climate change through the Internet are less likely to believe that climate change is caused by "entirely natural processes."

There is a relationship between the belief that climate change is caused by entirely natural processes and whether a person heard about climate change via a newspaper. Significantly more respondents who did not hear about climate change through a newspaper (77.4%*) said that climate change is caused by entirely natural processes. However, compared to the total sample (16.2%), a significantly smaller proportion of respondents who heard about climate change through newspapers (9.2%*) said that climate change is caused by entirely natural processes. This finding suggests that individuals who learnt about climate change through newspapers are less likely to believe that climate change is caused by "entirely natural processes".

5.13.4.1 Relationship between belief that climate change is caused by entirely natural processes and belief that climate change and its impact is the will of God

As noted already, there seems to be a relationship between the beliefs that climate change is caused by entirely natural processes and that it is the will of God, and that the two beliefs are not mutually exclusive.

Chi-square analysis indicates that there is a relationship between the belief that climate change is caused by "entirely natural processes" and that "climate change and its impact is the will of God". A significantly higher proportion (85.7%***) of respondents who believe that climate change is caused by entirely natural processes also agreed that "climate change and its impacts is the will of God" (Pearson chi-square is 24.939; Cramer's V is .355; *p*-value is .000). However, a significantly smaller proportion of respondents who, believe that climate change is caused by entirely natural processes (11.4%***) disagreed that "climate change and its impact is the will of God".

This finding implies that people who believe that climate change is caused by entirely natural processes are likely to agree that climate change and its impact is the will of God. Qualitative data supporting this finding was taken from the questionnaire:

> **Respondent E:** "I don't know the causes, but God does." [Male, young adult, Chikhwawa]

> **Respondent F:** "It's God who changes weather, climate and seasons." [Female, middle-aged, Salima]

Content analysis of the above responses indicates that the two respondents believe that climate change is caused by God. Note that they both said that climate change is caused by "entirely natural processes" and the responses are attempting to reinforce that belief. Whether this is influenced by religious beliefs or lack of scientific knowledge to explain climatic changes is beyond the scope of the thesis. Nonetheless, through this study we now come to understand that when Malawians talk about "natural processes" they may also mean "the will of God".

These findings are consistent with those of a qualitative study conducted by the BBC WST (2010) in ten African countries. The BBC WST study found that due to lack of a scientific understanding of climate change, most Africans—especially women, rural inhabitants and people with low level of education—resort to the use of existing knowledge and frames of reference, including "the will of God" to make sense of climate change phenomenon. However, these findings are inconclusive. There is need for more in-depth qualitative research on the relationship between belief that climate change is caused by natural processes and that climate change is the will of God.

5.13.4.2 Relationship between belief that climate change is caused by mostly natural processes and belief that climate change and its impact is the will of God

There is more evidence to support the view that Africans in general, and Malawians in particular use "the will of God" to make sense of the causes of climate change. Significantly more respondents who believe that climate change that climate change is caused by mostly natural processes (93.8%**) agree that climate change and its impact is the will of God (Pearson chi-square value is 14.975; Cramer's V is 0.275; *p*-value is .001). These findings suggest that individuals who believe that climate change is caused by either entirely natural processes or mostly natural processes are likely to agree that climate change and its impact is the will of God.

5.13.5 Summary: Relationship between source of information about climate change and causes of climate change

5.13.5.1 Natural processes and human activities

An analysis of the results indicates that 34.3% of the respondents believe that climate change is caused by a combination of natural processes and human activities. Significantly more respondents who heard about climate change through the Internet (61.1%**), television (57.7%**), newspaper (60.5%**), and formal education (58.3%**) believe that climate change is caused by "natural processes and human activities". In addition, 25.7% of the respondents said that climate change is caused by mostly human activities, particularly those who heard about it via political rallies (48.8%).

5.13.5.2 Entirely human activities

Some respondents (19.8%) believe that climate change is caused by entirely human activity. More respondents who have heard about climate change through family and friends (33.0%), mosque or church (41.4%), and political rally (51.2%) believe that climate change is caused by entirely human activity.

5.13.5.3 Entirely natural processes and the will of God

Interestingly, a significant higher proportion of respondents who said that climate change is caused by entirely natural processes (85.7%) also agreed that "climate change and its impacts is the will of God". This finding suggests that to some people "entirely natural processes" may mean "the will of God". A majority of these respondents who believe that climate change is caused by entirely natural processes have not heard about climate change through the Internet and newspapers. However, only small proportions who believe that climate change is caused by entirely natural processes heard about climate change via the Internet (5.6%) and newspapers (9.2%). It appears there is a strong belief among some Malawians that climate change and its impact is the will of God.

5.14 Certainty/uncertainty about effects of climate change

When respondents were asked the extent to which they agreed with the statement, "It is uncertain what the effects of climate change will be", 31.5% disagreed, 60.9% agreed and 7.6% expressed no opinion. Compared to the 56% who agreed that the causes of climate change are known, this means that a considerably smaller proportion of the respondents (32%) are certain about the effects of climate change. Further analysis shows that there is a relationship between certainty/uncertainty about the effects of climate change and socio-demographic characteristics. These socio-demographic variables include location, age, monthly household income and highest level of education. As I will discuss in Section 5.20.1, location, monthly household income and highest level of education also significantly influence perceptions about the impact of climate change on livelihoods. Suffice it to say that people who are more vulnerable to climate change effects seem to be uncertain about the effects of climate change.

Significantly more rural respondents (77.1%***) than urban respondents (14.7%***) agreed that the effects of climate change are uncertain (Pearson chi-square value is 91.545; Cramer's V=.563; *p*-value is .000). Ironically, this means that rural inhabitants, who are also more vulnerable to the effects of climate change, are uncertain about what the effects of climate change will be.

A significantly higher proportion of respondents who come from households with an income of less than MK30, 000 a month (78.7%***) agree that it is uncertain what the effects of climate change will be (Pearson chi-square value is 81.678; Cramer's V=.534; *p*-value is .000). (By comparison, those from households with a monthly income of MK30, 000 or above constitute 22.5%***.)This means that lower-income earners, who are also more vulnerable to climate change effects, seem to be uncertain about the effects of climate change.

Unsurprisingly, a significantly higher proportion of respondents who never attended school or attended only primary school (79.4%***) were uncertain about climate change effects. There were fewer uncertain respondents who had a secondary or tertiary education (36.3%***) (Pearson chi-square value is 55.677; Cramer's V=.439; *p*-value is .000). (I will also discuss in Section 5.20.1 that significantly more respondents who had never attended school or only attended a primary school agreed that their livelihoods had been negatively affected by climate change.)

Significantly more respondents aged 55 and over (82.9%**) were uncertain about the effects of climate change (Pearson chi-square value is 19.675; Cramer's V=.185; *p*-value is .003).

5.15 Psychological distance of climate change

Perceived distance of climate change and its impact on people's livelihood can influence support for voluntary and governmental actions to address climate change (Spence et al., 2011). There are four theorised dimensions of psychological distance of climate change, namely: temporal distance, social distance, geographic distance, and certainty and/or scepticism about climate change. While it has already been established that the USA and UK public are uncertain about climate change, perceive it as a moderate threat and that its impacts affect only geographically and temporally distant people and those yet to be born (cf. O'Connor et al., 1999; Leiserowitz, 2005; Slimak and Dietz, 2006), the study wanted to establish whether Malawians have similar perceptions.

5.15.1 Temporal distance of climate change

When asked, "When, if at all, do you think Malawi will start feeling the effects of climate change?" 78% of respondents said "we are already feeling the effects," 19% said in the "next 5 years," and 12% said "in the next 10 years and beyond". However, there are differences based on gender and highest level of education.

5.15.1.1 Temporal distance of climate change and gender

Chi-square analysis indicates that there is a relationship between gender and perceptions about temporal distance of climate change. A significantly higher proportion of men (82.8%*) think Malawi is already feeling the effects of climate change. However, compared to the total sample (78.1%), a smaller proportion of women (73.1%*) think Malawi is already feeling the effects of climate change. Thus, more men than women are likely to say Malawi is already feeling the effects of climate change.

A significant higher proportion of women (16.1%*) think Malawi would start feeling the effects of climate change in the next five years. Comparatively, a smaller proportion of men (4.0%*) are of the view that Malawi will start feeling the effects of climate change in the next five years.

Significantly more men (13.1%*) than women (10.8%*) think Malawi will start feeling the effects of climate change "in the next 10 years and beyond", compared to the total sample (12.0%).

5.15.1.2 Temporal distance of climate change and level of education

The study found that there is a relationship between temporal distance of climate change and highest level of education attended. Chi-square analysis indicates that a significantly higher proportion of respondents who had either a secondary school or tertiary education (85.4%*) said that Malawi is already feeling the effects of climate change. However, a significantly smaller proportion (70.8%*) of the respondents who had either never attended school or only attended said Malawi is already feeling the effects of climate change.

A significantly higher proportion of respondents who had either never attended school or only attended primary school (13.5%*) said Malawi will start feeling the effects of climate change in the next five years compared to those with more education (6.2%*).

Significantly more respondents (15.6%*) with little or no schooling held the view that Malawi will start feeling the effects "in the next 10 years and beyond". A significantly smaller proportion (8.3%*) of those with secondary or tertiary education thought this.

5.15.2 Geographic distance of climate change

Another questionnaire item measuring perception of geographic distance of climate change gave a different result. When asked to what extent respondents would agree or disagree with the statement "Climate change will mostly affect areas that are far away from here," 54% disagreed, 40% agreed, and 6% expressed no opinion. While a few studies in UK and USA found that the public there perceive climate change as a moderate threat and that it is likely to affect geographically distant people or nations and future generations (see Leiserowitz, 2005; O'Connor et al., 1999; Slimak & Dietz, 2006), this study found that Malawians think climate change is likely to affect their local geographic area. For instance, when asked: "What changes have you experienced? Please explain," some respondents gave the following responses:

> "Rainfall pattern has really changed. Nowadays rains come late. Also, more dry spells. As I'm talking rains in Bolero (my home area) stopped almost a month ago and our maize plants are drying." [Female, middle-aged, Statistician, Mzuzu city]

> "High temperatures: Mzuzu these days is becoming hotter than was the case 4 or 5 years ago. The rainfall pattern is also becoming unpredictable." [Male, young adult, Laboratory Technician, Mzuzu city]

> "We have not [received] sufficient rainfall for the last 10 years. This has resulted in the decrease of water levels in Lake Chilwa. [And] a decrease in the number of birds." [Male, young adult, Farmer and Fisherman, Zomba rural]

The narratives above show that respondents' local geographical areas (Zomba rural, Mzuzu city and Bolero in Rumphi district) have been affected by changes in climate manifested by insufficient rainfall, unpredictable rainfall patterns, high temperatures and drought.

Chi-square analysis indicates that there are statistically significant differences among respondents when it comes to the perception that climate change will mostly affect distant places. The differences are based on a number of variables including location, religion, monthly household income, highest level of education, and highest level of education in science-related subject.

5.15.2.1 Urban vs. rural

Compared to the total sample (54.1%), a significantly higher proportion of respondents from urban areas (73.7%***) disagreed with the statement "climate change will mostly affect areas that are far away from here", As anticipated, a significantly smaller proportion of rural respondents (47.2%***) also disagreed with the statement. This implies that both urban than rural residents are more likely to disagree that climate change will mostly affect distant areas. Expectedly, significantly more rural respondents (46.7%***) agreed that climate change will mostly affect areas that are far away from them. However, so did a significantly smaller proportion of urban respondents.

5.15.2.2 Religion

Chi-square analysis indicates that there is a relationship between the perception that "climate change will mostly affect areas that are far away from here" and religion. A significantly higher proportion of Christian respondents (58.1%**) disagreed with the statement "Climate change will mostly affect areas that are far away from here". However, a significantly smaller proportion of Muslim respondents (26.5%**) disagreed with this. Thus more Christians than Muslims in Malawi are likely to disagree that climate change will mostly affect areas far away from them. Significantly more Muslim respondents (70.6%**) and a smaller proportion of Christian respondents (36.0%**) said that "climate change will mostly affect areas that are far away from here".

5.15.2.3 Income

Unsurprisingly, more respondents whose monthly household income is MK30, 000 or more (71.1%***) disagreed with the statement "Climate change will mostly affect areas that are far away from here". However, a significantly smaller proportion of respondents (46.2%***) in lower-income households also disagreed with the statement. Thus higher-income earners are more likely to disagree that climate change will mostly affect distant areas. A significantly higher proportion of respondents whose monthly household income is less than MK30, 000 (48.2%***) agreed that climate change will mostly affect areas that are far away from here. In contrast, a smaller proportion of respondents who have a monthly household of more than MK30, 000 (23.3%***) agreed with the statement.

5.15.2.4 Level of education

The highest level of education obtained has an influence on perceptions about geographic distance of climate change. As expected, significantly more respondents who have either secondary or tertiary level education (66.4%**) disagreed that climate change will mostly affect distant areas. However, a significant smaller proportion of respondents who had little or no schooling (44.8%**) disagreed with the statement "Climate change will mostly affect areas that are far away from here". Unsurprisingly, a significant higher proportion of respondents who had either never attended school or only attended primary school (49.7%**) agreed with the statement "Climate change will mostly affect areas that are far away from here." However, 28.0%** of respondents who have education at either a secondary or tertiary level agreed with the statement.

5.15.3 Social distance of climate change

Studies conducted in Europe and USA found that the public perceive climate change as a threat to other societies and not necessarily themselves (Leiserowitz, 2005, 2006; Lorenzoni et al., 2007; Wibeck, 2014). This study wanted to examine Malawians' perception with regard to the social distance of climate change. To examine this, respondents were asked the extent to which they would agree or disagree with the statement "Climate change is likely to affect mostly developed countries". The study found that 56% disagreed, 34% agreed, and 10% expressed no opinion. Chi-square analysis results indicate that there are no statistically significant differences in the sample population based on socioeconomic and demographic characteristics.

5.15.4 Malawians are uncertain about what the effects of climate change will be

When the respondents were asked the extent to which they agree or disagree with the statement "It is uncertain what the effects of climate change will be," 60.9% agreed, 31.5% disagreed and 7.6% expressed no opinion. Despite a majority of respondents (70.3%) who believe that climate change is happening, almost 61% of respondents believe that the effects of climate change are unknown. Thus more respondents (61%) believe that the effects of climate change are unknown than known (55.5%). What accounts for this uncertainty regarding the effects of climate change?

Some studies seem to suggest that people's beliefs, perceptions and attitudes towards climate change are influenced by content of the messages about climate change that the sources disseminate to the general public (Fortner et al., 2000; Corbett & Durfee, 2004; Krosnick et al., 2006. Chi-square analysis indicates that when it comes to uncertainty regarding the effects of climate change, there are indeed differences within the study population based on source of information about climate change.

A significantly greater proportion of respondents who heard about climate change through television (49.5%***) than those who have not heard via television (23.5%***) disagreed with the statement ,"It is uncertain what the effects of climate change will be". Significantly more respondents who are single (never married) (92.9%***) than those married (36.2%***) and either divorced or widowed (22.7%***) had heard about climate change through television (92.9% ***). This finding implies that people who hear about climate change through television are likely to admit that they know what the effects of climate change will be. This finding is consistent with previous studies that have established that exposure to television is associated with an increase in belief in the existence of climate change (Krosnick et al., 2006).

Significantly more respondents who heard about climate change through the Internet (69.7%***) than those who did not (21.4%***) disagreed with the statement "It is uncertain what the effects of climate change will be". This finding suggests that individuals who get information about climate change through the Internet are likely to say that they know what the effects of climate change will be.

Significantly more respondents who heard about climate change through newspapers (50.5%***) than those heard from other sources (23.2%***) disagreed with the statement, "It is uncertain what the effects of climate change will be". This finding suggests that Malawians who hear about climate change through a newspaper are likely to disagree that the effects of climate change are not known. This finding is inconsistent with previous research by Krosnick et al (2006) who found that exposure to newspapers was associated with less belief in the existence of climate change.

A significantly higher proportion of respondents who heard about climate change through formal education (48.9%***) than those who have not (25.7%***) disagreed with the statement, "It is uncertain what the effects of climate change will be". This finding implies that people who hear about climate change through formal education are more likely to say that they are certain about what the effects of climate change will be.

A significantly higher proportion of respondents who had heard about climate change through environmental groups (46.2%**) than other sources (27.8%**) disagreed with the statement "It is uncertain what the effects of climate change will be". This finding suggests that citizens who hear about climate change through environmental groups are more likely to be certain about what the effects of climate change will be.

5.16 Blame for climate change

As we have noted, Malawians are inclined to think that human beings are to a large extent responsible for causing climate change. Despite the fact that the majority of Malawians are uneducated and not well versed with the scientific facts about climate change issues, they still believe that climate change is largely anthropogenic. Obviously, Malawians have seen wanton cutting down of trees and degrading of the environment being done by fellow Malawians and therefore are predisposed to blame human beings for causing climate change.

When asked, "In your opinion, who is responsible for causing climate change?" 56.2% of the responses laid the blame on "all people worldwide", 17.4% developed countries, 8.5% the local community, 2.7% developing countries, 1.3% "Other" and 0.9% blamed it on themselves (see Table 5.5).

Table 5.5: A frequency table showing percentage distribution of respondents with regard to blame for causing climate change

Respondents' belief about who to blame for causing climate change (N=198)			
Belief about blame for climate change	**Responses**		**Percent of Cases**
	N	Percent	
All people	126	56.3%	63.6%
You personally	2	.9%	1.0%
Your local community	19	8.5%	9.6%
Developed countries	39	17.4%	19.7%
Developing countries	6	2.7%	3.0%
Not sure	23	10.3%	11.6%
God	6	2.7%	3.0%
Other	3	1.3%	1.5%
Total	**224**	**100.0%**	**113.1%**

Three respondents chose "Other." One of them had a unique response, saying, "Whatever or whoever society engages in activities that are detrimental to the climate is responsible for climate change". Thus, this respodent did not want to blame any specific institution or entity for causing climate change. The other two respondents put the blame on "the Devil". Surprisingly, a rather higher proportion of responses (10.3%) chose "Not sure" and, interestingly, 2.7% put the blame on "God". Considering that "God" and "the Devil" were not included as response categories, these findings are very important for the study. It means altogether there were 8 responses (3.5%) blaming spiritual entities for causing climate change. Comparatively, there were more respondents (3.5%) blaming "God" and "the Devil" than themselves (2%) for causing climate change. When these responses are ranked, this is the result (in descending order): "all people worldwide"; "developed countries"; "local community"; "God"; "developing countries"; and "other."

Religious beliefs play a role in people's uptake of climate science. A study by Rudiak-Gould (2012) investigating climate change attitudes in the Marshall Islands found that religious beliefs have influence on public uptake of climate science. While some islanders believed that climatic changes are caused by God as predicted in the book of Revelation, others believed that God would not cause nationwide inundation because he promised in the book of Genesis never to flood the earth again.

5.16.1 Human beings are to a large extent responsible for climate change

The study found that 56% of respondents believe that human beings are responsible for causing climate change. In terms of ranking blame for climate change, human beings come first. When respondents are later asked to what extent they agree or disagree with the statement "Human beings are to a large extent responsible for climate change," 85% agreed, 13% disagreed, and 2% expressed no opinion.

It seems obvious to assume that the belief about cause(s) of climate change should relate to an individual's belief about who to blame for causing climate change. Arguably, people who believe that climate change is caused by either entirely natural processes or mostly natural processes are less likely to believe that people are responsible for causing climate change than those who believe that climate change is caused by natural processes and human activities, mostly human activities, and entirely human activity. To test this hypothesis, Chi-square analysis was performed. The analysis indicates that when it comes to the belief that "all people worldwide" are responsible for causing climate change, there are significant differences among respondents based on two beliefs, namely: the belief that climate change is caused by entirely natural processes and the belief that climate change is caused mostly by natural processes.

5.16.1.1 Relationship between the belief that climate change is caused by entirely natural processes and the belief that all people worldwide are to blame for causing climate change

When it comes to belief about blame for causing climate change, there are differences based on whether a respondent believes climate change is caused by "entirely natural processes". In comparison to the total sample (63.6%), a smaller proportion of respondents who believe that climate change is caused by entirely natural processes (37.1%***) also believe that "all people worldwide" are to blame. The finding suggests that people who believe that climate change is caused by entirely natural processes are less likely to blame "all people worldwide" for causing climate change. As discussed in Section 5.12.5, people who believe that climate change is caused by either entirely natural processes or mostly natural processes are likely to agree that climate change and its impact is the will of God.

5.16.1.2 Relationship between belief that climate change is caused by mostly natural processes and belief that all people worldwide are to blame for causing climate change

Chi-square analysis indicates that there is a relationship between the belief that climate change is caused by mostly natural processes and the belief that all people are responsible for causing climate change. The analysis indicates that compared to the total sample (63.6%), a significantly smaller proportion of respondents who believe that climate change is caused by mostly natural processes (37.5% *) believe that "all people worldwide" should take the blame for causing climate change.

These findings suggest that people who do not believe that climate change is caused by mostly natural processes are likely to blame "all people worldwide" for causing climate change. The study has already shown that people who believe that climate change is caused by mostly natural processes are likely to agree that climate change and its impact is the will of God (refer to Section 5.12.5).

5.16.2 Developed countries should take the most blame for climate change

The study found that 17% of respondents believe that developed countries are to blame for causing climate change. In terms of ranking, developed countries come second. When respondents were later asked to what extent they agree or disagree with the statement "Developed countries should take the most blame for climate change," 57% agreed, 32% disagreed, and 11% expressed no opinion.

Comparatively, most respondents (85%) agreed with the statement "Human beings are to a larger extent responsible for climate change, whereas only 57% agreed with the statement "Developed countries should take the most blame for climate change" (for comparative analysis refer to Section 5.8.3). This implies that a majority of Malawians believe that human beings (and not developed countries) should take the most blame for climate change. Chi-square analysis of responses indicates that when it comes to blaming developed countries to for causing climate change, there are no differences based on people's beliefs about causes of climate change.

5.17 Concern about climate change

Malawi is most vulnerable to climate change and variability because its economy is agro-based and agriculture depends on rainfall (Environmental Affairs Department (EAD), 2002a, 2002b, 2012). This means that changes in climate (including rainfall patterns), affect agricultural production. According to *The Malawi Population and Housing Census 2008 Main Report* (NSO, 2009) a majority of Malawian rural inhabitants (84.7%) depend on subsistence agriculture. This means that only 15.3% of urban inhabitants do not solely depend on agriculture for their livelihoods. Although climate change will have different impacts on Malawians depending on their livelihoods, the majority of respondents perceive climate change as a serious threat that will affect not only the general Malawian population but also their personal wellbeing. When asked the extent to which the respondents would agree or disagree with the statement, “Climate change does not threaten me”, the majority (81%) disagreed, 13% agreed and 6% neither agreed nor disagreed.

5.17.1 Concern about climate change to the Malawian society

Most of the respondents (97.9%) see climate change as a threat to the Malawian society. When respondents were asked to indicate how concerned they were that climate change would affect the Malawian society negatively, 90.3% said that they were very concerned, 7.6% were concerned and 2.2% were not concerned. Chi-square analysis of the responses indicates that when it comes to degree of concern that climate change will negatively affect the Malawian society, there are no differences among respondents based on their socioeconomic and demographic characteristics.

5.17.2 Concern about climate change to the individual

The study found that respondents were concerned about the negative impact of climate change on their individual wellbeing. The study asked respondents to indicate on a 5-point scale how concerned they were that climate change would negatively affect them personally. At analysis stage, there were only three (3) categories. The findings indicate that 85.3% were very concerned, 11.5% were concerned and 3.2% were not concerned. Thus 96.8% of respondents were concerned that climate change would negatively affect them personally. Comparatively, a Gallup Poll on climate change conducted on the American public shows that 64% of Americans do not think climate change poses a serious threat to them personally or their way of life in their lifetime (Gallup Environment Poll, 2013). Chi-square analysis of responses indicate when it comes to degree of concern over the negative effects of climate change on respondents themselves, there are differences based on location, monthly household income and highest level of education attended.

Significantly more rural respondents (90.7%***) than urban respondents (70.3%***) said they are very concerned that climate change would negatively affect them personally. A significant higher proportion of respondents who had either never attended school or only attended primary school (92.9%***) said they were very concerned that climate change would negatively affect them personally, as opposed to those with higher levels of education (75.4%***). So too were those with a lower household income (less than MK30, 000 per month) (92%***) compared with those who were better off (households that have MK30, 000 or more every month (85.5%***).

These findings suggest that less-educated, lower-income earning and rural Malawians are more likely to be very concerned about the negative effects of climate change than other fellow Malawians. The findings are consistent with previous research (Krosnick et al., 2006). Krosnick and colleagues found that the belief about whether climate change is a problem is a function of relevant personal experience (with weather). Since most rural people are farmers, they do have relevant personal experience with daily weather and its impact on agricultural production.

5.17.3 Concern about climate change in relation to other environmental and socioeconomic problems

A substantial amount of research on risk perception seems to suggest that people are inclined to address climate change only when they perceive it as a high risk. In other words, there is a causal relationship between climate risk perception and willingness to address the issue. It is therefore important that we understand how the climate change issue is perceived by people as this has influence on their support for voluntary and government policies to address the issue (O’Connor et al., 1999; Bord et al., 1998; Leiserowitz, 2005). This study asked respondents to indicate how they perceive climate change in relation to other socioeconomic and environmental problems facing the world, Malawi and them personally.

5.17.3.1 Concern about climate change in relation to other global problems

The study wanted to establish respondents' concern over climate change in relation to other global problems. Respondents were asked to rate on a 5-point scale (from 1=not serious at all, to 5=extremely serious) their concern of nine problems considered to be some of the major challenges the world is facing presently. The list included increasing world population, armed conflicts, HIV/AIDS, global economic downturn, crime, poverty, lack of food and drinking water, air pollution and spread of diseases. The analysis shows that when the nine global problems are ranked on the basis of their mean concern scores, climate change comes almost towards the end (sixth) out of the nine global problems (see Figure 5.4 below). Figure 5.4 depicts a ranking of respondents' concern over climate change in relation to other environmental and socioeconomic problems affecting the world at the moment on the basis of their mean concern scores (represented by yellow/longer bars) and respective standard deviations (represented by black/shorter bars).

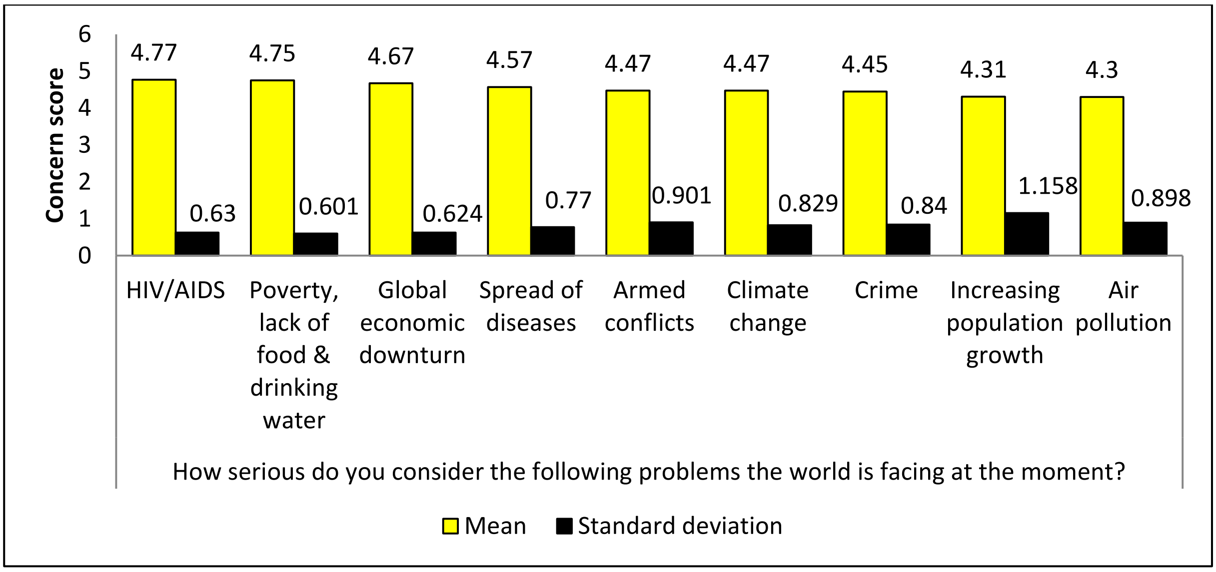

Figure 5.4: A bar graph showing ranking of concern over climate change in relation to environmental and socioeconomic problems the world is facing on the basis of mean concern score

Figure 5.4 shows that respondents perceive HIV/AIDS (mean concern score is 4.77 out of 5) as the most serious problem the world is facing. Climate change is ranked sixth out of the nine problems. The finding suggests that while climate change (with a mean concern score of 4.47) is more important than air pollution, increasing population growth and crime, however, it is less important than HIV/AIDS; poverty, lack of food and drinking water; global economic downturn; spread of diseases; and armed conflicts. Note that the mean concern score for climate change is above 4. This means that in relation to the other eight items, respondents perceive climate change as a serious problem facing the world today. The same applies to the rest of the nine items whose mean concern scores are also above 4.

5.17.3.2 Concern about climate change in relation to other problems Malawi is facing

The study also asked respondents to rate on a 5-point scale (from 1=not serious at all, to 5=extremely serious) the level of concern for climate change in relation to other environmental and socioeconomic problems Malawi is facing at the moment. A list eight problems considered to be Malawi's major socioeconomic and environmental problems was provided to respondents. Analysis indicates that when these problems are ranked on the basis of mean concern scores, climate change comes fifth out of eight (see Figure 5.5). Figure 5.5 depicts a ranking of respondents' concern over climate change in relation to other environmental and socioeconomic problems affecting the world at the moment on the basis of their mean concern scores (represented by yellow/longer bars) and respective standard deviations (represented by black/shorter bars).

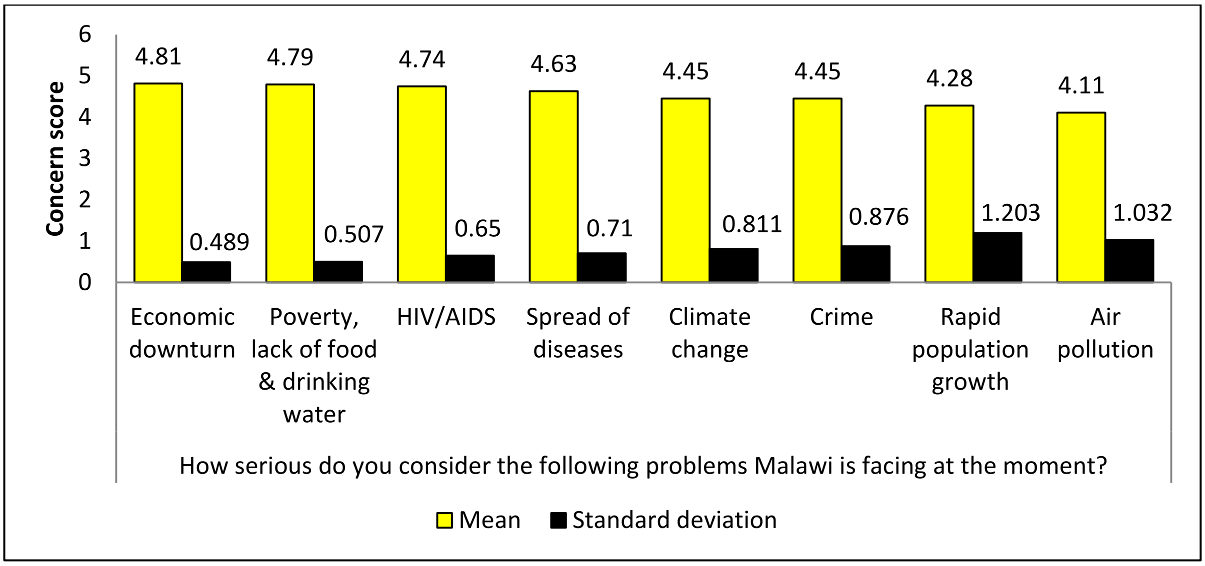

Figure 5.5: A bar graph showing ranking of concern over climate change in relation to environmental and socioeconomic problems Malawi is facing on the basis of mean concern score

Figure 5.5 shows that out of the eight socioeconomic and environmental problems, economic downturn (with a mean concern score of 4.81 out of 5) is considered as the most serious problem in Malawi. Climate change is ranked fifth (with a concern score of 4.45 out of 5). Air pollution is considered as the least serious problem out of the eight. This finding suggests that climate change is not a significant problem in relation to other problems. This finding is inconsistent with the findings of the 2009 and 2011 Eurobarometer surveys investigating Europeans' perceptions of climate change (Eurobarometer, 2009, 2011). While the 2009 Eurobarometer poll found that climate change was ranked as the third most serious problem the world is facing, the 2011 Eurobarometer survey found that Europeans perceived climate change as the second most serious problem of the world.

It is worth noting that although climate change is ranked fifth by respondents in Malawi, its mean concern score is above 4. This means that in relation to the other seven problems, respondents still perceive climate change as a serious problem that Malawi is facing. Thus, although climate change is a serious problem, so are the other problems as they each have a mean concern score of above 4.This finding is inconsistent with previous research (Shisanya & Khayesi, 2007; Bord et al., 1998). A study conducted in Nairobi, Kenya, by Shisanya and Khayesi (2007) found that in relation to 21 other socioeconomic and environmental problems, climate change was not perceived as a significant problem. Among the problems that ranked higher than climate change in Kenya included corruption, unemployment, crime, poverty, HIV/AIDS, and prostitution, among others.

5.17.3.3 Concern about climate change in relation to other problems affecting individual persons

Furthermore, the study asked respondents to rate on a 5-point scale (from 1=not serious at all, to 5=extremely serious) the level of concern for climate change in relation to other environmental and socioeconomic problems individuals are currently facing. A list of eight problems considered to be Malawi's major socioeconomic and environmental problems was provided to respondents. When these problems are ranked on the basis of their mean concern scores, the analysis shows climate change comes almost in the middle (fifth) See Figure 5.6. Figure 5.6 depicts a ranking of respondents' concern over climate change in relation to other environmental and socioeconomic problems currently affecting individuals on the basis of their mean concern scores (represented by yellow/longer bars) and respective standard deviations (represented by black/shorter bars).

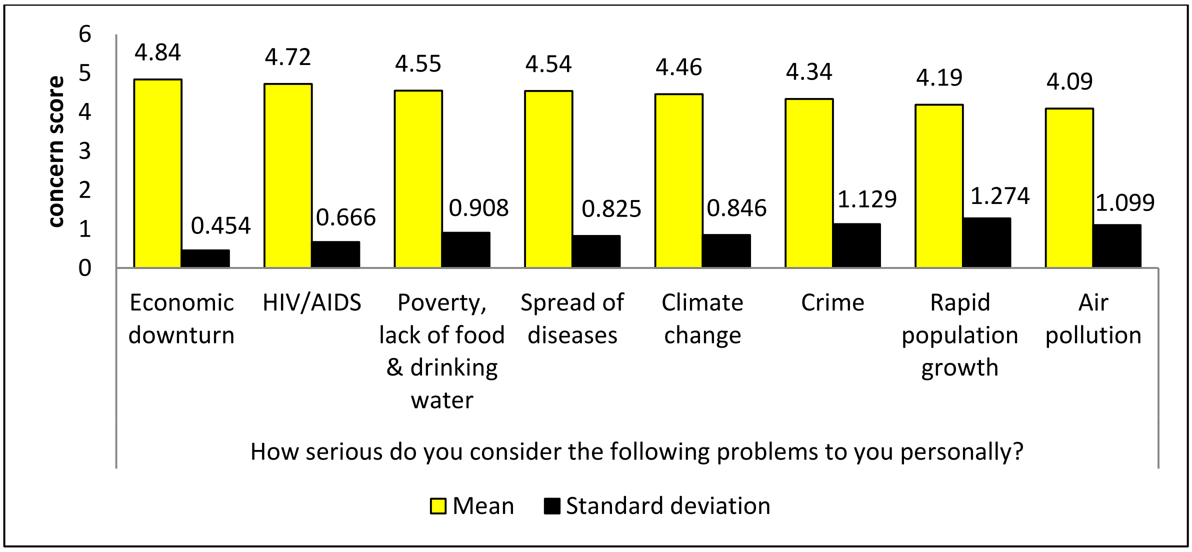

Figure 5.6: A bar graph showing ranking of concern over climate change in relation to environmental and socioeconomic problems individuals are facing on the basis of mean serious score

Figure 5.6 shows that at a personal level, the seriousness of climate change is surpassed by other socioeconomic problem, which include spread of diseases (mean concern score is 4.54), poverty, lack of food and drinking water (4.55), HIV/AIDS (4.72) and the economic downturn (4.84). With regard to the ranking of climate change, the picture we get from Figure 5.6 is not different from the one in Figure 5.5. In both figures climate change is ranked fifth out of eight (note that the list of socioeconomic and environmental problems is the same). However, the only difference is with the concern score; 4.45 in Figure 5.5 and 4.46 in Figure 5.6, suggesting that climate change is comparatively considered a slightly more serious problem at personal level (mean concern score 4.46) than at national level (4.45).

Although climate change is ranked fifth, note that the mean concern score for climate change is above 4. This means that in relation to the other items, respondents perceive climate change as a serious individual problem. The other problems are also considered as serious since each of them has a concern score which is above 4. This finding seems to be inconsistent with a study by Bord and colleagues (1998) who analysed USA and international surveys and found that climate change compared to other personal, social and environmental issues is perceived as a moderate risk, and cautioned that we should not hastily conclude that climate change is a 'front-burner' issue (Bord et al., 1998: 77).

5.18 Solution to the problem of climate change rests with God

When respondents were asked the extent to which they would agree or disagree with the statement, “The solution to the problem of climate change rests with God,” 55% agreed, 39% disagreed, and 6% expressed no opinion. This finding indicates that there are mixed feelings about what the solution to climate change could be. Chi-square analyses of responses indicate that belief that the solution to the problem of climate change rests with God is influenced by socio-demographic characteristics and beliefs about causes of climate change. The socio-demographic characteristics include place of residence, gender, religion, monthly household income and education. The beliefs about causes include: belief that climate change is caused by entirely natural processes; belief that climate change is caused by mostly natural processes; and belief that climate change is caused by natural processes and human activities.

As discussed earlier in sections 5.13.4.1 and 5.13.4.2, individuals who believe that climate change is caused by either entirely natural processes or mostly natural processes are also likely to believe that climate change and its impact is the will of God. Chi-square analysis was performed to find out if there is a relationship between the belief that climate change and its impact is the will of God and the belief that the solution to the problem of climate change rests with God. The results of the analysis show that significantly more respondents who believed that climate change and its impact is the will of God (88.5%***) also agreed that the solution to the problem of climate change rests with God (Pearson chi-square value is 172.975; Cramer’s V is .546; *p*-value is .000).

Chi-square analysis indicates that a significant higher proportion of respondents who believed that climate change is caused by entirely natural processes (91.4%***) agreed that the solution to climate change rests with God (Pearson chi-square value is 32.267; *p*-value is .000; Cramer’s V is .404). However, 8.6%*** of respondents who believed that climate change is caused by entirely natural processes agreed that God holds the key to the solution of climate change.

Significantly more respondents who believed that climate change is caused by mostly natural processes (93.8%**) agreed that the solution to climate change rests with God (Pearson chi-square value is 32.267; *p*-value is .000; Cramer’s V is .404). However, only 6.3% of respondents who believed that climate change is caused by mostly natural processes agreed that the solution to climate change rests with God.

Interestingly, the analysis indicates that equal proportions of respondents who believed that climate change is caused by a combination of natural processes and human activities (43.5%*) agreed and disagreed that the solution to the problem of climate change rests with God (Pearson chi-square value is 5.972; Cramer's V is .174; *p*-value is .050). Another interesting finding is that a significant proportion of respondents who believed that climate change is caused by natural processes and human activities (13%*) could neither agree nor disagree that the solution to climate change rests with God. These findings suggest that Malawians are religious people and use the frame of reference "the will of God" not only to make sense of the causes of causes of climate change but also how to solve it (see BBC WST, 2010).

Further chi-square analysis indicates that a significantly higher proportion of respondents who agreed with the statement, "There is nothing I can do to slow down the effects of climate change" (89.3%***) also agreed with the statement "The solution to the problem of climate change rests with God".

The following groups are significantly more likely to agree that the solution to the problem of climate change rests with God: Rural respondents (72.9%***) than urban respondents (5.3%***); women (64.3%**) than men (55.2%**) (Pearson chi-square value is 11.065; Cramer's V is .195; *p*-value is .004); Muslims (82.4%**) than Christians (51.0%**) (Pearson chi-square value is 12.326; Cramer's V is.207; *p*-value is .002); those in lower-income households (less than MK30, 000) (75.1%***) than those who come from households that have a monthly income of MK30, 000 or more (13.3%***) (Pearson chi-square value is 102.974; Cramer's V is .599; p-value is .000); and respondents with little or no education (80.0%***) than those with a secondary school or tertiary education (22.4%***).

These findings suggest that the majority of people who do not have adequate information about climate change and are vulnerable to climate change effects believe that God holds the key to solving climate change. As discussed in Section 5.7.2 and Section 5.10.3, rural residents, women, lower-income earners and less-educated people are more likely to have inaccurate information about climate change and are vulnerable to climate change effects.

5.19 Perceptions and beliefs influencing initiatives to address climate change in Malawi

However, when asked the extent to which they would agree or disagree with the statement "The seriousness of climate change is exaggerated," 57% disagreed, 30% agreed and 13% expressed no opinion.

These findings suggest that while the majority of respondents (81%) agreed that climate change is a threat, however only 57.2% disagreed that "The seriousness of climate change is exaggerated". Further analysis indicates that 27.7% of respondents who disagreed with the statement "Climate change does not threaten me", also agreed with the statement "The seriousness of climate change is exaggerated". In other words, over a quarter of the respondents who perceive climate change as a threat think that the seriousness of climate change is exaggerated. But what accounts for the differences in perceptions about the seriousness of climate change? Chi-square analysis indicates that when it comes to perceptions about the seriousness of climate change, there are differences among respondents based on a number of variables including location, political beliefs, religion, age, gender, education, ethnicity and income.

Compared with the total sample (57.2%), analysis indicates that significantly higher proportions of respondents who disagreed with the statement "The seriousness of climate change is exaggerated" include:

- urban respondents (67.1%***), rather than rural respondents (53.7%***);
- Christian respondents (60.1%**), rather than Muslim respondents (32.4%**);
- respondents who hold conservative and liberal political beliefs (58.1%* and 61.2%*, respectively), rather than those who are neutral (50.0%*);
- respondents aged between 45-54 (58.8%*) and those over 55 years (63.4%*), as opposed to those aged between 18 and 44 years (55.6%*);
- respondents from the following ethnic groups: Chewa (64%*), Tumbuka (67.4%*), and Sena and Mang'anja (combined)[21] (70.4%*), but less Ngonis (57.4%*), Lomwes (48.3%*), Tonga (57.1%*), and Yao (35.1%*);

[21] The two ethnic groups of Sena and Mang'anja were combined to create one variable. Demographically, a majority of the Sena and Mang'anja speaking people are found in the lower Shire district of Chikhwawa. However, Manag'anja speaking people can also be found in the Southern districts of Chiradzulu and Zomba.

- respondents from households with a monthly household income of MK30, 000 or more (62.2%***) than those who come from households whose monthly income is less than MK30, 000 (54.8%***);
- respondents who have a secondary school or tertiary education (62.4%**) as opposed to those with little or no schooling (53.3%**); and
- respondents who took a science-related subject at secondary school (62.9%**), rather than those who had never taken a science-related subject or only done so at primary school (53.3%**).

5.20 Climate change and livelihoods

Some of the urban dwellers also practise agriculture and are therefore negatively affected by climate change. The study has found that of the 241 rural inhabitants 92.5% are farmers, but of the 76 urban respondents only 15.8% are farmers. This means that in addition to being employees of Malawi government, private sector and parastatal organisations, 15.8% of urban respondents also engage in farming. An analysis of the responses on livelihood indicates that Malawians do have multiple livelihoods. For instance, a Malawi government employee may be a farmer and also a businessperson. Or, a farmer could also be engaged in business to supplement his income. The distribution of respondents with respect to livelihoods implies that over 90% of the respondents are likely to indicate that they are concerned that climate change will negative affect their livelihood (see Table 5.6).

Table 5.6: Frequencies of a cross-tabulation for respondents' livelihood and location

Relationship between livelihood and location (n=290)				
Respondents' livelihoods		**Location of interview**		**Total**
		Rural	**Urban**	
Businessperson	Count	73	21	94
	% within livelihood	77.7%	22.3%	
	% within location	34.1%	27.6%	
Farmer	Count	198	12	210
	% within livelihood	94.3%	5.7%	
	% within location	92.5%	15.8%	
Fisherman	Count	15	1	16
	% within livelihood	93.8%	6.3%	
	% within location	7.0%	1.3%	
Government of Malawi employee	Count	5	31	36
	% within livelihood	13.9%	86.1%	
	% within location	2.3%	40.8%	
Private sector employee	Count	5	23	28
	% within livelihood	17.9%	82.1%	
	% within location	2.3%	30.3%	
Parastatal employee	Count	0	16	16
	% within livelihood	0.0%	100.0%	
	% within location	0.0%	21.1%	
A casual worker	Count	65	0	65
	% within livelihood	100.0%	0.0%	
	% within location	30.4%	0.0%	
Other	Count	6	5	11
	% within livelihood	54.5%	45.5%	
	% within location	2.8%	6.6%	
	Count	**214**	**76**	**290**

It is noteworthy that there is also a relationship between livelihood and monthly household income (see Table 5.7).

Table 5.7: Frequencies of a cross-tabulation for respondents' livelihood and monthly household income

Relationship between livelihood and monthly household income (n=287)				
Respondents' livelihood		**Household income per month**		**Total**
		<MK30, 000	**MK30, 000 and above**	
Businessperson	Count	65	29	94
	% within livelihood	69.1%	30.9%	
	% within income	33.0%	32.2%	
Farmer	Count	184	25	209
	% within livelihood	88.0%	12.0%	
	% within income	93.4%	27.8%	
Fisherman	Count	14	1	15
	% within livelihood	93.3%	6.7%	
	% within income	7.1%	1.1%	
Government of Malawi employee	Count	2	33	35
	% within livelihood	5.7%	94.3%	
	% within income	1.0%	36.7%	
Private sector employee	Count	4	24	28
	% within livelihood	14.3%	85.7%	
	% within income	2.0%	26.7%	
Parastatal employee	Count	0	16	16
	% within livelihood	0.0%	100.0%	
	% within income	0.0%	17.8%	
A casual worker	Count	64	1	65
	% within livelihood	98.5%	1.5%	
	% within income	32.5%	1.1%	
Other	Count	6	4	10
	% within livelihood	60.0%	40.0%	
	% within income	3.0%	4.4%	
	Count	**197**	**90**	**287**

Table 5.7 shows that 88.4% of respondents who are farmers and fishermen have monthly household income of less than MK30, 000, compared to only 7.6% of respondents who are civil servants, private sector employees and employees at parastatal organisations. Most of the respondents who are civil servants, employees by parastatals and private sector (92.4%) also have a monthly household income of MK30, 000 or more, as compared with only 11.65% of the farmers and fishermen. This finding means that concern over the impact of climate change on livelihood will be exacerbated by a lower income.

5.20.1 Malawians' livelihoods have been negatively affected by climate change

Considering that over 80% of Malawians depend on rain-fed agriculture for their livelihoods, erratic and unpredictable rainfall patterns are likely to have an impact on agricultural production. When asked the extent to which respondents would agree or disagree with the statement, "My livelihood has been negatively affected by climate change", 80.7% agreed, 7.7% disagreed and 11.4% expressed no opinion. However, chi-square analysis of the responses indicates that when it comes to agreeing or disagreeing with the statement, there are significant differences among respondents based on place of residence, monthly household income and highest level of education.

Unsurprisingly, significantly more rural respondents (91.1%***) than urban respondents (51.3%***) agreed with the statement "My livelihood has been negatively affected by climate change" (Pearson chi-square value is 58.872; Cramer's V=.451; *p*-value is .000). A significant higher proportion of urban respondents (17.1%***) disagreed that their livelihood had been negatively affected by climate change. This finding suggests that rural inhabitants are more likely to agree that their livelihood has been negatively affected by climate change.

For instance, when asked, "What changes [in weather, climate and environment] have you experienced? Please explain", some respondents gave the following responses:

> "Poor harvests for the past 4 years." [Male, young adult, Farmer and Businessman, Mzimba]

> "The harvests are decreasing each and every year. The rainfall pattern is unpredictable." [Female, middle-aged, businesswoman, Mangochi]

> "The decrease of water level in Lake Chilwa. A reduction of the amount of fish caught in the lake." [Male, young adult, Farmer and Fisherman, Zomba rural]

A significantly higher proportion of respondents whose household income is less than MK30, 000 every month (91.4%***) than those who come from households with an income of MK30, 000 or more (57.8%***) agreed with the statement: "My livelihood has been negatively affected by climate change" (Pearson chi-square value is 46.705; Cramer's V=.403; *p*-value is .000). This finding means that individuals who come from households with a monthly income of less than MK30, 000 are more likely to agree that their livelihood has been negatively affected by climate change.

As anticipated, significantly more respondents with little or only primary school education (92.1%***) as opposed to those who had attended secondary or tertiary education institutions (65.6%***) agreed with the statement "My livelihood has been negatively affected by climate change" (Pearson chi-square value is 34.235; Cramer's V=.344; *p*-value is .000). This finding suggests that Malawians who have either never attended school or only have a primary school education are likely to agree that their livelihood has been negatively affected by climate change.

5.20.2 Malawians' farming has been negatively affected by climate change

Malawians' agricultural production has been negatively affected by the impact of climate change. Since Malawi depends on rain-fed farming, changes in climate must have negative effects on farming. When asked the extent to which respondents would agree or disagree with the statement, "My farming has been negatively affected by climate change", 86.2% agreed, 7.6% disagreed and 6.2% expressed no opinion. This finding suggests that a majority of Malawians perceive that their farming has been negatively affected by climate change.

Chi-square analysis of responses indicates that significantly more rural dwellers (95.3%***) than urban respondents (60.5%***) agreed that their farming had been negatively affected by climate change (Pearson chi-square value is 60.386; Cramer's V is .456; *p*-value is .000). (Note that the strength of the relationship is moderate).

Significantly more individuals who come from households whose monthly income is less than MK30, 000 (94.9%***) than those whose households have MK30, 000 or more monthly

(68.9%***) agreed that their farming a significantly smaller proportion of respondents had been negatively affected by climate change (Pearson's chi-square value is 40.125; Cramer's V is .374; *p*-value is .000). Note that at least 70% of urban residents agreed that their farming has also been negatively affected by climate change. (Also note that the strength of the association is moderate).

Significantly more respondents who had never attended school or had only attended primary school (94.5%***) than those who had a secondary school or tertiary education (75.2%***) agreed that their farming had been negatively affected by climate change (Pearson's chi-square value is 24.116; Cramer's V is .288; *p*-value is .000). Note that three-quarters of the urban respondents agreed that their farming had been affected by climate change.

5.20.3 Relationship between perception about impact of climate change on livelihood and perception about impact of climate change on farming

If Malawians perceive that their livelihoods have been negatively affected by climate change, then it follows that they would also perceive that their farming has also been negatively affected by climate change. Chi-square analysis of responses indicates that a significantly higher proportion of respondents who agreed that their livelihood had been negatively affected by climate change (96.6%***) agreed that their farming had been negatively affected by climate change. Consistent with other findings of the study, a significantly higher proportion of respondents who agreed with the statement, "My farming has been negatively affected by climate change" (90.4%***) also agreed with the statement "My livelihood has been negatively affected by climate change".

5.20.4 Degree of concern over impact of climate change on individual's livelihood

The study wanted to establish degree of concern about the impact of climate change on their personal livelihoods. The respondents were therefore asked, "How serious do you consider the impact of climate change to be on your livelihood?". 84.6% said 'very serious," 13.2% said "serious,' and 2.1% said 'not serious at all'. Thus 97.8% of the respondents perceived the impact of climate change on their livelihoods as serious. As discussed in Section 5.12.1, 85.3% of the respondents were also very concerned that climate change would personally negatively affect them. Chi-square analysis of responses indicates that when it comes to degree of concern over impact of climate change on personal livelihood, there are differences among respondents based on location, monthly household income and highest level of education.

Significantly higher proportions of respondents from rural areas (91.7%***), respondents from households with a monthly income of less than MK30, 000 (91.5%***), and respondents who have no or only primary schooling (91.7%***) considered the impact of climate change on their livelihoods to be very serious.

5.20.5 When did climate change start to impact on your livelihood?

The study wanted to establish the exact time that climate change started to have negative effects on people's livelihoods. Climate change is not a new phenomenon. However, its effects have become more pronounced in the last few decades. When asked, "If your livelihood has been negatively impacted by climate change, when do you think climate change started to have this effect on it?", 73.7% said 1-10 years ago, and 26.3% said over 10 years ago. This finding suggests that the majority of Malawians feel the effects of climate change have already begun. Comparatively, more Malawians (73.7%) than Americans (54%) feel they have started to experience the effects of climate change (see Gallup 2013 Environment Poll). Further analysis revealed that when it comes to perception about time when climate change started to negatively impact one's livelihood, there are differences in the study population based on location, income and highest level of education.

Chi-square analysis of responses indicates that there is a relationship between perception about time when climate change started to impact on one's livelihood and place of residence. Significantly more rural respondents (78.3%**) than urban respondents (57.7%**) indicated that they started experiencing the negative effects of climate change on their livelihoods in the last ten years. Unsurprisingly, a significantly higher proportion of urban respondents (42.3%**) than rural respondents (21.7%**) started experiencing the effects of climate change on their livelihoods in the last ten years.

Significantly more respondents who come from households with a monthly income less than MK30, 000 (78.6%*) than respondents whose households have a monthly income of MK30, 000 or more (63.6%*) indicated that they started experiencing the negative effects of climate change on their livelihoods in the last ten years. A higher proportion of respondents with a greater monthly income (36.4%*) than those with a lower income (21.4%%*) started experiencing the effects of climate change on their livelihoods in the last ten years. These findings mean that higher-income earners are more likely to have experienced the effects of climate change on their livelihood in the last ten years.

More respondents with little or no education (80.9%**) than those with at least a secondary school education (63.2%**) started experiencing the effects of climate change on their livelihoods in the last ten years. As expected, a significant higher proportion of respondents who had either attended secondary school or tertiary education (36.8%**) than those who had either never been to school or only a primary school (19.1%**) started experiencing negative effects of climate on their livelihoods over ten years ago. These findings suggest that better educated Malawians are more likely to have started experiencing the effects of climate change on their livelihood beyond ten years.

These findings suggest that rural inhabitants, the less-educated and low-income earners are likely to have experienced the effects of climate change in the last ten years. This is consistent with studies conducted in Alaska and Florida (USA) and United Kingdom (Arctic Climate Impact Assessment, 2004; Leiserowitz & Broad, 2008; Spence et al., 2011; Li et al., 2011; Weber & Stern, 2011), which found that individuals whose economic livelihood depends on weather and climate events (i.e., farmers and fishers) and normally use personal experience to detect changes in climate, are inclined to give recent events more weight than distant events. Weber and Stern (2011: 319) also commented that detecting changes through personal experience has the tendency to make people overreact to rare weather events but also to underestimate the future devastating effects of climate change.

5.21 Responsibility for addressing climate change

The study also wanted to establish which entities/institutions should take the most responsibility for addressing climate change than others. To do this, the study asked respondents to rate on a 5-point scale (1=not responsible at all; 5=to a large extent responsible) the extent of responsibility which seven entities/institutions have for addressing climate change. The results of the analysis are shown in Figure 5.7 which depicts a ranking of entities considered most responsible for addressing climate change in Malawi, on the basis of their mean responsibility scores (represented by blue/longer bars) and respective standard deviations (represented by black/shorter bars).

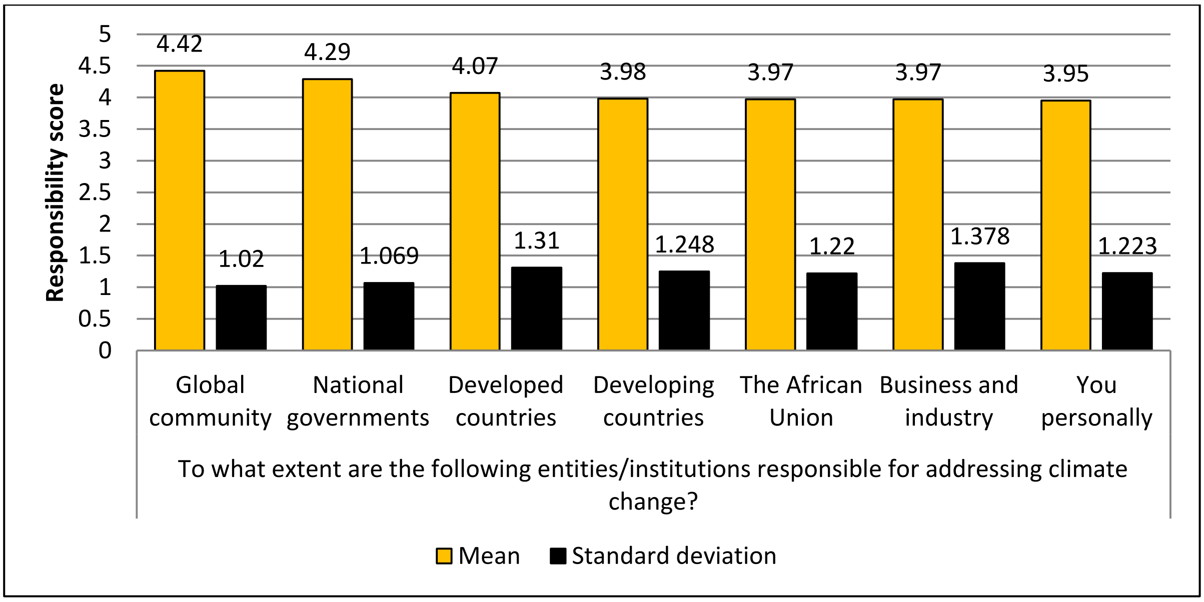

Figure 5.7: A bar graph showing ranking of entities/institutions considered most responsible for addressing climate change on the basis of mean responsibility score

Figure 5.7 shows that when the entities are ranked on the basis of their mean responsibility scores, global community is ranked first (with a mean responsibility score of 4.42 out of 5), national governments come second (4.29), developed countries are ranked third (4.07) and developing countries are ranked fourth (3.98). Interestingly, individual respondents themselves think they are the least responsible for addressing climate change. But note the relatively high mean responsibility scores across all the items, suggesting that respondents think that all the entities have a responsibility to address climate change.

5.22 Public willingness to support the implementation of a Malawi National Climate Change Policy

In its efforts to stabilise the emission of greenhouse gases into the atmosphere and to promote measures of adapting to the impacts of climate change, the Government of Malawi through the National Climate Change Programme in the Ministry of Environment and Climate Change Management (a ministry that was established in 2012) is in the process of developing a national climate change policy. At the moment the document is in a draft form. The overall goal of the policy is:

> "…To promote climate change adaptation and mitigation for sustainable livelihoods through measures that increase levels of knowledge and understanding and improve human wellbeing and social equity, while promoting economic development that significantly reduces

environmental risks and ecological scarcities" (*Malawi National Climate Change Policy* (Draft), 2012: 8).

Against this background, the study wanted to ascertain Malawians' willingness to support a national climate change should the Malawi government implement it. The respondents were asked to rate on a 5-point scale (1=not willing at all; 5=very willing) their willingness to support a prospective national climate change policy. The responses show that 68.6% said they were very willing, 30.7% willing and only 0.6% not willing. This means that 99.3% of the respondents are willing to support the implementation of a national policy on climate change. Although Malawi is not a homogenous society and therefore does not have a homogenous set of beliefs about causes climate change and how the problem should be solved, based on these results, the majority of Malawians appear to be willing to support the implementation of a national climate change policy should it be adopted by Government.

5.22.1 Relationship between concern over impact of climate change on individual's livelihood and willingness to support the implementation of a national climate change policy

Malawians are concerned about the impact of climate change on their livelihoods. Malawians also perceive that climate change has negatively affected their livelihood. With 84.7% of Malawians living in rural locations and depending on rain-fed agriculture for their livelihoods, one would expect that most Malawians should be concerned about the impact of climate change on their livelihoods.

Chi-square analysis of responses indicates that significantly more respondents who agreed that their livelihood had been negatively affected by climate change (100%*) were also willing to support the implementation of the policy. However, in comparison to the total sample (99.3%), a significantly smaller proportion of respondents who did not think that their livelihoods had been negatively affected by climate change (95.7%*) were also willing to support the policy.

Chi-square analysis also shows that significantly more respondents who consider the impact of climate change on their livelihood as very serious (100%***) than those who consider the impact as serious (97.3%***) and not serious at all (83.3%***) were willing to support the implementation of a national climate change policy.

These findings mean that respondents' willingness to support the implementation of climate change policy depends on their climate change risk perceptions; people who perceive the impact of climate change on their livelihood as serious are likely to be more willing to support the implementation of climate change policy than those who perceive the impact as moderate. This finding is consistent with previous research suggesting that climate change risk perceptions matter in predicting willingness to support policy to address climate change (O'Connor et al., 1999; Leiserowitz, 2005; Zahran et al., 2006).

5.23 Taking personal initiative to address climate change

Individual Malawians have an important role to play in addressing climate change. Malawians should not just sit and wait for the Government of Malawi to develop a national climate change; individuals too must be motivated to take voluntary actions to address climate change. When asked "Have you ever taken any action to address climate change?" a significant proportion of respondents who did not think "The seriousness of climate change is exaggerated" (60.6%*) said 'yes', while a significantly smaller proportion of respondents who said that the seriousness of climate is exaggerated (44.0%*) also said 'yes'. These findings suggest that people who perceive climate change as a serious problem are likely to take action to mitigate climate change. This is consistent with previous research findings that people who perceive climate change as a high risk are more likely to take voluntary action to address climate change (O'Connor et al., 1999; Bord et al., 2000; Leiserowitz, 2005; Krosnick et al., 2006).

The study wanted to know what action the proactive respondents had taken to address climate change. Below are some of their responses:

> "I use organic manure instead of fertilizers" [Male, middle-aged, Lilongwe city]

> "Quitting smoking. Using [a] fuel effective vehicle with limited carbon dioxide emission." [Female, middle-aged, Blantyre city]

> "Planting trees at home, and disposing of wastes in the right way." [Male, middle-aged, Mzuzu city]

> "Planted trees. Started practising zero tillage." [Male, young adult, Farmer, Chikhwawa]

> “We planted 120 tree seedlings, and 115 have survived.” [Female, young adult, Businessperson and Farmer, Mzimba rural]

> “Irrigating my field using a treadle pump.” [Male, young adult, Farmer, Lilongwe rural]

> “I’m applying manure. Started livestock farming.” [Female, old-aged, Farmer, Mzimba rural]

> “I follow good farming practices. For instance, I do not burn maize stalks when I'm making ridges.” [Female, middle-aged, Businessperson and Farmer, Ntcheu]

The above responses indicate that Malawians who perceive climate change as a serious problem and think that action should be taken to address the issue are likely to take voluntary steps to mitigate climate change.

The study also found that compared to the total sample (33.3%), significantly more respondents who agreed that their livelihood had been negatively affected by climate change (57.8%*) had also taken action to address climate change. This finding suggests that individuals who perceive that their livelihood has been negatively affected by climate change are more likely to take voluntary action to address climate change.

However, there are some beliefs and perceptions that may hinder personal initiatives to address climate change. Compared to the total sample (45.8%), a significant higher proportion of respondents who believe that the solution to the problem of climate change rests with God (52.6%**) have also never taken personal action to address climate change. This suggests that people who believe that the solution to the problem of climate change rests with God are less likely to take action to address climate change.

Compared to the total sample (45.6%), significantly more respondents who agree that they are uncertain about the nature of the effects of climate change (50.6%**) have also never taken personal action to address climate change. This finding suggests that if people are uncertain about what the effects of climate change will be, they are less likely to take personal action to address climate change.

5.24 Conclusion

Climate change is a complex scientific phenomenon whose scientific understanding eludes many people including those who are highly educated. Understanding climate change in Malawi appears to be confined to a few urban people. Thus the majority of Malawians (84.7%) who live in rural areas and are less educated do not understand the scientific facts of the climate change issue. This means that the Malawians who are most vulnerable to the effects of climate change, also do not have a scientific understanding of the issue. In this context the proponents of the deficit model of PUS have a point in advocating for science education to the members of the public. However, caution should also be exercised by science communicators and policymakers when pursuing their efforts to educate the public about climate change. There is a need to understand the contextual issues and to take them into account when communicating climate change science to the public.

Arguably, Malawians' understanding of climate change is relational. Malawians are aware that climate has changed and the majority of Malawians who live in rural areas depend on rain-fed agriculture for their livelihood. They relate to the natural environment on a daily basis. This enables rural inhabitants to accumulate a wealth of indigenous knowledge with respect to changes in their weather, climate and environment. Malawians have noticed that there have been remarkable changes in climate and believe that climate change is happening. Not only have rural Malawians noticed changes in climate, but they are also able to offer explanations for the remarkable changes they have observed in their climate. In their lay understanding of science, Malawians are also able to articulate the causes and effects of climate change, who is to blame and how to address climate change. They also perceive climate change as a serious threat to their livelihood and their primary source of awareness about it is personal experience. In other words, the majority of the members of the Malawian public understand climate change, only their understanding of the issue is different from that of scientific experts.

Much of the lay understanding of climate change issue in Malawi is shaped by pre-existing local knowledge and beliefs. While most of them are convinced that it is largely caused by human activities, others believe that climate change is either due to entirely natural processes or mostly natural processes. Interestingly, some Malawians in rural locations believe that climate change and its impacts is the will of God. As argued earlier, “the will of God” is one of the frames of reference used by some Malawians to make sense of climate change in the absence of scientific understanding of the issue. Malawians also believe the climate change is caused by ‘deforestation’, ‘will of God’, ‘depletion of ozone layer’, ‘bad agricultural practices’ and ‘overpopulation’. These and other frames of reference enable lay people to make sense of climate change. This implies that Malawians use these frames of reference to renegotiate with ‘new’ scientific information about climate change. This poses a major challenge for public education about climate change. Thus, in order to effectively and efficiently communicate climate change information to the Malawian public, science communicators and policymakers need to understand the contextual issues and other factors that influence the public understanding of the climate change issue. It means that interpretivist theorists do have a point when they insist that scientists and other stakeholders need to understand the social context first, before embarking on educating the public about any scientific issue including climate change.

Malawians have also heard about climate change from secondary sources. These secondary sources include radio, television, the Internet, formal education, environmental groups, family members and/or friends, churches or mosques, and non-governmental groups, among others. However, of the people who report having heard about climate change through those sources, only a few are able to give accurate responses about the causes of climate change and what can be done to address climate change. The study found that exposure to certain sources of information such as newspapers, the Internet, environmental organisations, and institutions of learning (especially secondary schools, colleges and universities) provide people with a better understanding of climate change science than sources such as friends, family members, village headmen, politicians, and churches and mosques. Thus, perceptions and attitudes towards climate change are to a large extent determined by the sources individuals use to get information about climate change.

The study also found that the nature of climate change information an individual receives—which eventually forms the person’s body of beliefs, perceptions and attitudes about climate change—is also dependent on which sources of information about climate change are consulted. The most reliable and trustworthy sources of information about climate change are formal education, scientists, Internet and environmental groups. People who use these sources appear to have more accurate information about climate change. For instance, many urban residents and the educated who learnt about climate change through formal education, demonstrate correct scientific understanding of climate change. Note that there are other sources of information that are considered trustworthy but they do not appear to disseminate accurate climate change information. Two of the sources considered most trustworthy by rural inhabitants, low-income earners, the uneducated, and those who are married, divorced or widowed are village headmen and politicians, but they do not appear to disseminate accurate information about climate change. Unsurprisingly, rural inhabitants, lower-income earners and the uneducated display incorrect understanding of climate change.

Malawians' perceptions, attitudes and beliefs about climate change are also influenced by certain socioeconomic, demographic and household characteristics. It has also been established that there are moderate relationships among these variables. The findings of the study suggest that in order for science communicators to effectively communicate climate change information to the public, they ought to understand the interactions between these variables so as to address hindrances to the public understanding of climate change in Malawi. In addition, the findings provide insights into opportunities and challenges with respect to public support of climate change policies in Malawi.

By utilising qualitative and quantitative data methodologies in a single study, this study provides a wider perspective on public understanding of climate change in Malawi. While some studies carried out in Africa, for instance BBC WST (2010) and Shisanya & Khayesi (2007) used quantitative and qualitative research approaches, respectively, this study not only establishes the existence of relationships between variables, but goes further by supporting the quantitative analyses with qualitative data.

More discussion on variables—identified through multinomial regression analysis—that best predict Malawians' perceptions, beliefs and attitudes towards climate change will follow in the next chapter (Chapter 6).

CHAPTER 6

FACTORS PREDICTING BELIEFS, PERCEPTIONS AND ATTITUDES TOWARDS CLIMATE CHANGE IN MALAWI

6.1 Introduction

This chapter attempts to develop models that would enable us to predict Malawians' perceptions, beliefs and attitudes towards climate change. As discussed in Chapter 5, chi-square analyses were used to establish relationships between two variables. I attempted to show that there are relationships between socio-demographic characteristics, and between measures of perceptions, beliefs and attitudes towards climate change and other variables. On the basis of the findings discussed in Chapter 5, multinomial logistic regression was performed to identify which of the factors could be used to predict Malawians' perceptions, beliefs and attitudes towards climate change.

Specifically, the chapter addresses the following two questions: (i) What factors predict Malawians' perceptions, beliefs and attitudes about climate change? (ii) Does the impact of climate change on an individual's livelihood significantly predict their perceptions, beliefs and attitudes about climate change?

Before regression analyses could be performed, it was necessary to perform principal components analysis (PCA) on question 25 of the survey (question 25 of the survey was a matrix of 21 statements relating to perceptions, attitudes and beliefs about climate change). The aim was to identify 'clusters' or groups of related variables from the 21 statements (or variables) relating to perceptions, beliefs and attitudes towards climate change. PCA reduced the number of outcome variables to thirteen (shared by four components). Section 6.2 discusses the results of the factor analysis, which was based on the PCA of responses to question 25 of the survey.

Having reduced the number of outcome variables to thirteen, the next task entailed identifying independent (or predictor) variables that could be entered into the models. On the basis of findings discussed in Chapter 5, twelve predictor variables were identified: location, gender, religion, highest level of education, monthly household income, marital status, number of children, number of household members, region, sources of information about climate change, trustworthiness of source fo information about climate change and level of concern about the impact of climate change on an individual’s livelihood. Section 6.3 discusses the rationale for selecting these independent variables.

With the outcome and predictor variables identified, multinomial logistic regression analyses were performed to develop models that could predict Malawians’ perceptions, beliefs and attitudes towards climate change. Section 6.4 discusses the results of the analyses and interpretations of the models. For practical purposes, the study uses the abbreviations *, **, and *** to indicate that the *p*-value is significant (0.01-0.05), very significant (0.001-0.01), and extremely significant (<0.001), respectively. Section 6.5 concludes by giving a summary of factors that are able to predict perceptions, beliefs and attitudes towards climate change in Malawi.

6.2 Principal Components Analysis of question 25 (statements regarding perceptions, beliefs and attitudes towards climate change)

In this section I present and discuss the results of the factor analysis, which was based on the PCA of responses to question 25 of the survey. As mentioned, question 25 of the survey was a matrix of 21 statements relating to perceptions, attitudes and beliefs about climate change. The question read, “To what extent do you agree or disagree with the following statements? For each statement please tick the appropriate option”, and the response options were ‘strongly disagree’, ‘disagree’, ‘neither agree nor disagree’, ‘agree’, and ‘strongly agree’.

All 21 items relating to perceptions, beliefs and attitudes towards climate change were subject to PCA using SPSS version 20. Before performing PCA, it was important to verify the suitability of the data for factor analysis. The inspection process revealed that the data were indeed suitable for factor analysis for the following reasons: firstly, there were a number of coefficients of .3 and above; secondly, the Kaiser-Meyer-Olkin value was .78, exceeding the recommended value of .6 (Kaiser 1970, 1974); and thirdly, Bartlett’s Test of Sphericity was significant (p =.000) (see Bartlett, 1954). Since all three conditions were satisfied, it was deemed appropriate to perform factor analysis (see Table 6.1).

Table 6.1: Suitability of data set for factor analysis: KMO and Bartlett's Test of Sphericity

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.780
Bartlett's Test of Sphericity	Approx. Chi-Square	1532.493
	df	210
	Sig.	.000

PCA revealed that there were six components with eigenvalues exceeding 1, explaining 19.7%, 13%, 8.5%, 6.3%, 5.6% and 4.8% of the variance, respectively (see Table 6.2).

Table 6.2: Total variance explained by the six components with eigenvalues exceeding 1

Total Variance Explained							
	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.136	19.697	19.697	4.136	19.697	19.697	3.688
2	2.737	13.035	32.732	2.737	13.035	32.732	2.676
3	1.787	8.509	41.241	1.787	8.509	41.241	2.733
4	1.328	6.324	47.565	1.328	6.324	47.565	1.385
5	1.178	5.612	53.177				
6	1.007	4.794	57.971				
7	.928	4.421	62.392				
8	.852	4.059	66.452				
9	.798	3.798	70.250				
10	.757	3.607	73.857				
11	.710	3.382	77.239				
12	.683	3.253	80.491				
13	.619	2.947	83.438				
14	.578	2.754	86.192				
15	.552	2.629	88.821				
16	.529	2.518	91.339				
17	.466	2.218	93.557				
18	.441	2.099	95.657				
19	.404	1.921	97.578				

20	.267	1.273	98.851				
21	.241	1.149	100.000				
Extraction Method: Principal Component Analysis.							
a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.							

It was also necessary to inspect the screeplot to see whether there was a clear break in the shape of the plot. Inspection of the screeplot revealed a clear break after the fourth component (see Figure 6.1).

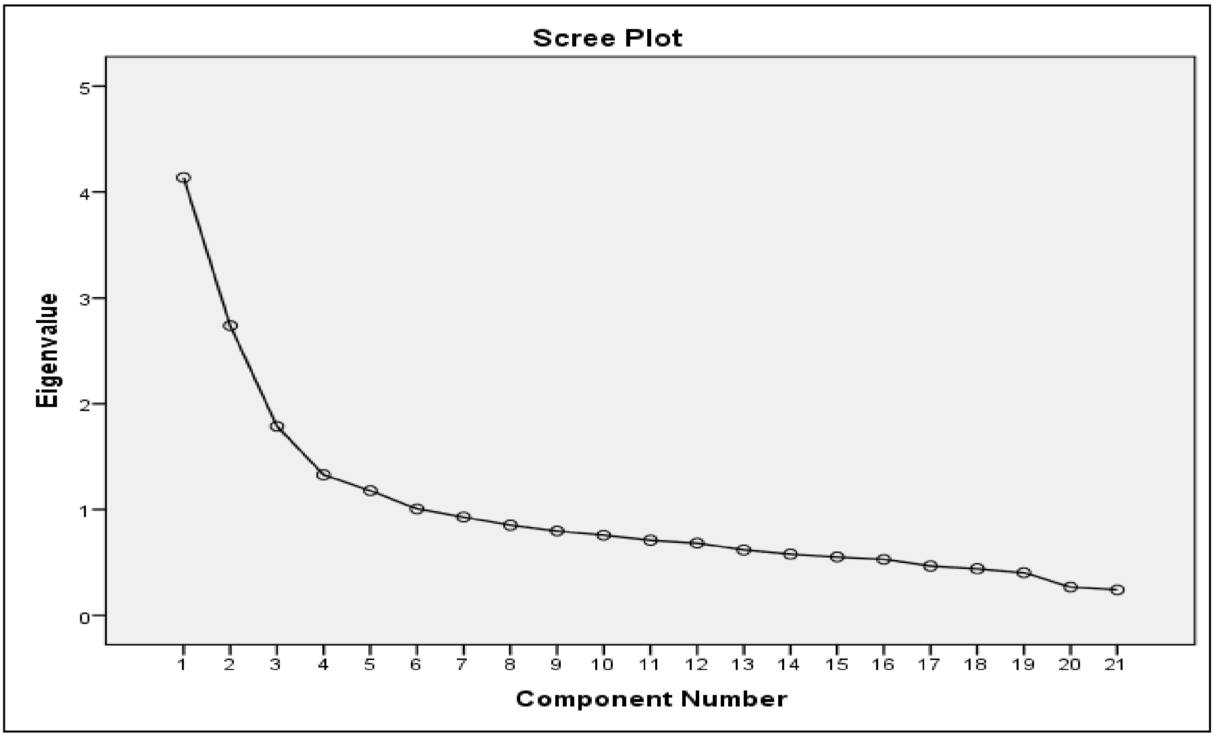

Figure 6.1 Screeplot resulting from PCA of 21 items on perceptions, beliefs and attitudes towards climate change

As can be seen in Figure 6.1 above, there is a break after the fourth component. According to Catell (1966) this means that only four components would be retained for further investigation.

In addition, to further validate the decision to select four components, another procedure required calculating the average eigenvalues using a computer software program called Monte Carlo PCA for Parallel Analysis,[22] and then systematically comparing these eigenvalues with

[22] Monte Carlo PCA for Parallel Analysis is a statistical program that was developed by Marley Watkins (2000). It is an important tool for generating 100 sets of random data of the same size as one's real data. It is a

those obtained in SPSS. If the SPSS value is greater than the value generated by the program, this factor is retained; otherwise it is rejected. The results of the parallel analysis vindicated my earlier decision from the screeplot that only four out of the six components should be retained. The results of this process is summarised in Table 6.3.

Table 6.3: Output from parallel analysis compared with eigenvalues obtained in SPSS

Component number	**Actual eigenvalue from PCA**	**Criterion value from parallel analysis**	**Decision**
1	4.136	1.5152	accept
2	2.737	1.4172	accept
3	1.787	1.3472	accept
4	1.328	1.2908	accept
5	1.178	1.2386	reject
6	1.007	1.1895	reject

Note: Monte Carlo PCA for Parallel Analysis results were calculated on the basis of 21 variables, 290 study participants and of course, 100 replications. Out of the six eigenvalues obtained in SPSS only four have values greater than the corresponding values obtained by parallel analysis.

While the six components explained a total of 58% of the variance, the four-component solution explained a total of 47.6% of the variance with component 1 contributing 19.7%, component 2 contributing 13%, component 3 contributing 8.6% and component 4 contributing 6.3%. Pallant (2010) argues that performing oblimin rotation does help in the interpretation of extracted components. The results of performing oblim rotation provided a somewhat simpler structure, with the four components showing relatively strong loadings (i.e., more than .3) and all variables but three loading substantially on only one component. More specifically, there are six variables loading on component 1; seven variables loading on component 2; seven variables loading on component 3; and four variables loading on component 4. Three variables are shared by three components: 25o ("It is uncertain what the

prerequisite that an individual enters three pieces of information into the program: the number of variables you are analysing; the number of participants in your sample; and the number of replications (specify 100). For the principal components analysis for question 25, there are 21 variables; 290 participants. Upon generating these average eigenvalues, all you do is to systematically compare these with those you obtained in SPSS. If your value is larger than the one generated by Parallel Analysis, you retain it; otherwise it is rejected. (See Watkins, 2000; also see Pallant 2010: 193).

effects of climate change will be") is shared by components 1 and 2; 25j ("It is already too late to do anything about climate change") is shared by components 1 and 3; and 25i ("Developed countries should take the most blame for climate change") is shared by components 3 and 4 (see Table 5.9).

Table 6.4: Pattern and Structure Matrix for PCA with Oblimin Rotation of Four Factor solution of statements relating to perceptions, beliefs and attitudes towards climate change

	Pattern Matrix[a]				**Structure Matrix[a]**				**Communalities**
	Component				**Component**				
	1	2	3	4	1	2	3	4	
Q25p. The solution to the problem of climate change rests with God	**0.804**	0.098	0.072	0.084	**0.812**	0.087	0.246	0.035	.454
Q25e. Climate change and its impact is the will of God	**0.78**	0.06	0.01	0.034	**0.778**	0.049	0.179	-0.017	.303
Q25d. The causes of climate change are not known	**0.72**	-0.013	0.1	0.061	**0.738**	-0.025	0.258	0.011	.402
Q25o. It is uncertain what the effects of climate change will be	**0.66**	**0.307**	0.051	0.005	**0.666**	0.295	0.185	-0.022	.558
Q25h. There is nothing I can do to slow down the effects of climate change	**0.591**	-0.041	0.133	0.052	**0.617**	-0.052	0.264	0.009	.611
Q25f. Human beings are to a large extent responsible for climate change	-0.582	0.299	**0.306**	0.239	-0.537	**0.312**	0.172	**0.3**	.530
Q25t. My livelihood has been negatively affected by climate change	0.181	**0.797**	-0.116	0.093	0.136	**0.803**	-0.103	0.126	.508
Q25u. My farming has been negatively affected by climate change	0.201	**0.758**	-0.041	0.059	0.175	**0.76**	-0.022	0.089	.403
Q25s. Some catastrophes such as floods and tsunamis make me believe that climate change is happening	-0.096	**0.577**	0.05	-0.043	-0.092	**0.575**	0.009	-0.002	.413
Q25n. Changes in daily temperature of this area make me believe that climate change is happening	0.159	**0.506**	0.011	-0.178	-0.267	**0.503**	-0.094	0.262	.393
Q25r. The concentration of greenhouse gases in the	-0.238	**0.485**	-0.028	0.217	0.166	**0.493**	0.027	-0.159	.461

atmosphere leads to changes in climate									
Q25m. Climate change is likely to affect mostly developed countries	-0.081	-0.069	**0.722**	0	0.077	-0.092	**0.707**	0.009	.531
Q25l. Climate change will mostly affect areas that are far away from here	0.197	0.13	**0.645**	-0.098	**0.343**	0.099	**0.683**	-0.097	.510
Q25g. The seriousness of climate change is exaggerated	0.194	-0.123	**0.626**	-0.05	**0.336**	-0.151	**0.672**	-0.063	.304
Q25c.Perception_Uncertainty/Scepticism about climate change: I am uncertain that climate change is happening	0.158	-0.142	**0.555**	-0.051	0.285	-0.167	**0.594**	-0.064	.540
Q25i. Developed countries should take the blame for climate change	-0.176	0.209	**0.478**	**0.362**	**0.452**	0.173	**0.478**	-0.036	.682
Q25j.Attitude_Willingness to take action to mitigate climate change: It is already too late to do anything about climate change	**0.365**	0.194	**0.405**	-0.026	-0.1	0.216	**0.436**	**0.392**	.371
Q25b. We need to preserve the environment for future generations	0.054	0.123	-0.394	**0.371**	-0.06	0.157	-0.382	**0.37**	.367
Q25a. Humans were meant to rule over the rest of nature	0.024	0.171	-0.167	**0.623**	-0.058	0.212	-0.161	**0.63**	.341
Q25k. My local area is likely to be affected by climate change	-0.037	**0.346**	-0.017	-0.605	-0.004	**0.312**	-0.043	-0.582	.688
Q25q. Climate change does not threaten me	0.247	-0.356	0.171	**0.397**	0.262	-0.342	0.241	**0.361**	.617

The PCA revealed some interesting findings:

- There are four variables loading on component 1 with loadings of .6 and above. This cluster of variables (i.e., Q25d, Q25e, Q25o and Q25p)—arranged in descending order of their loadings—relates to respondents' certainty/uncertainty about the causes, effects and solution to climate change.
- There are two variables loading on component 2 with loadings of .6 and above. These two variables (Q25t and Q25u) relate to the perceived threat or impact of climate change on people's livelihoods and farming.
- There is a cluster of three variables (Q25m, Q25l and Q25g) on component 3 with loadings of .6 and above. These variables relate to the psychological distance of climate change and scepticism about climate change. This interpretation is consistent with previous research on theorised psychological distance of climate change (Spence et al., 2011).

- There is only one variable (i.e., Q25a) loading on component 4 with loading of .6 and above. This variable relates to belief about the relationship between humans and the environment.

It is also important to note the following (refer to Table 6.5 Component Correlation Matrix):

- There is a weak negative correlation between factors 1 and 2; and between factors 1 and 4. However, there is a weak positive correlation between factors 1 and 3.
- There is a weak negative correlation between 2 and 1; and between 2 and 3. However, there is a weak positive correlation between factors 2 and 4.
- There is a weak positive correlation between factors 3 and 1; and between factors 3 and 4. However, there is a weak negative correlation between factors 3 and 2.
- There is a weak negative correlation between factors 4 and 1. However, there is a weak positive correlation between factors 4 and 2; and between 4 and 3.

Table 6.5: Component correlation matrix

Component Correlation Matrix				
Component	1	2	3	4
1	1.000	-.016	.218	-.070
2	-.016	1.000	-.034	.058
3	.218	-.034	1.000	.011
4	-.070	.058	.011	1.000
Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.				

On the basis of findings of the PCA discussed above, ten out of twenty-one variables were selected to be used as outcome variables in regression analyses. These variables were selected because their loadings were .6 and above. From component 1, the following were selected: Q25p, Q25e, Q25d and Q25o. Q25t and Q25u were selected from component 2., and Q25m, Q25l and Q25g from component 3. Only one variable (that is, Q25a) was selected from component 1 to be used as an outcome variable in a regression analysis.

6.3 Multinomial logistic regression

In the previous chapter we discussed the nature of relationships between two variables i.e., between demographic characteristics, or between other variables. But it is yet to be established which of the many independent variables are able to predict Malawians' perceptions, beliefs and attitudes towards climate change. In order to determine this, we need to perform regression analysis. Regression analysis enables one to develop models that can be used to predict values of the outcome variable from one or more predictor variables (Field, 2009). Specifically, the study employs the multinomial logistic regression technique because we would like to predict values of outcome variables with more than two response categories. All statements that constitute question 21 have five response options namely: 'strongly disagree', 'disagree', 'neither agree nor disagree', 'agree', and 'strongly agree'. At analysis stage these response categories were conflated to three, namely: agree, neither agree nor disagree, and disagree.

6.3.1 Selection of predictor and outcome variables

As discussed in Chapter 5, some socio-demographic characteristics, source of information and beliefs about causes of climate change seem to have a relationship with beliefs, perceptions and attitudes towards climate change. However, it is almost impossible to include all these variables in a regression analysis. Two criteria were used to select predictor variables: firstly, a test for multicollinearity (this occurs when two or more predictor variables in a regression are strongly correlated) which can seriously affect the parameters of a regression model (Field, 2009; Pallant, 2010), and secondly, ensuring that correlations between the dependent variable and independent variables were above .3 (Pallant, 2010). As expected, these undertakings identified a number of collinear variables. For instance there was a strong correlation between the following variables: location and monthly household income ($r=.88$); location and the Internet as a source of climate change information ($r=.81$); highest level of education and highest education in science-related subject ($r=1.0$); location and television as source of information about climate change ($r=.71$); television as source of information about climate change and newspaper as source of information about climate change ($r=.71$); Internet as source of information about climate change and monthly household income ($r=.76$). Also, there were several predictor variables that were weakly correlated with dependent variables. Overall, only six (6) predictor variables were selected to be entered into multinomial regression analysis. These are: location, level of education; and newspapers, environmental groups, formal education and the trustworthiness of village headmen as sources of information about climate change. As can be noted, two of these (i.e., location and highest level of education) are demographic characteristics; three (newspapers, environmental groups and formal education) are sources of information about climate change; and trustworthiness of source of information about climate change (i.e., village headmen).

The selection of outcome variables was largely dependent on the strength of correlation between the respective outcome variable and predictor variables. Outcome variables were selected if, and only if, they were moderately correlated (i.e., r=.3 or above) with three or more predictor variables that were selected for regression analysis. As a consequence, there were only five outcome variables that met this criterion. These outcome variables included: one variable regarding certainty/uncertainty about causes of climate change: "The causes of climate change are not known"; one variable regarding certainty/uncertainty about the effects of climate change: "It is uncertain what the effects of climate change will be"; one variable relating to belief about the causes of climate change: "Climate change and its impact is the will of God"; one variable relating to belief about solution to climate change: "The solution to the problem of climate change rests with God"; and one variable regarding perception about impact of climate change on an individual's livelihood: "My livelihood has been negatively affected by climate change".

6.4 Results of multinomial logistic regression analyses

In the sections that follow I present and discuss the results of multinomial regression analyses performed to develop models that predict Malawians' perceptions, beliefs and attitudes towards climate change. The results of the analyses are consistent with chi-square analyses discussed in Chapter 5.

6.4.1 Certainty/uncertainty about causes of climate change: The causes of climate change are not known

Multinomial logistic regression was performed to investigate the impact of factors on certainty/uncertainty about causes of climate change. The full model contained six independent variables (location, level of education; the following sources of information about climate change: newspapers, environmental groups, and formal education; and the trustworthiness of village headmen as source of information about climate change). Table 6.6

shows that the decrease in unexplained variance from the baseline model (188.262) to the final model (88.84) is 99.422 and this is significant, $p < .000$. Table 6.7 shows that the predicted values from the model do not differ significantly from observed values, meaning that the model is a good fit of the data. Table 6.8 shows that the model as a whole explained between 31.1% (Cox and Snell R square) and 38.5% (Nagelkerke R square) of the variance with respect to being certain or uncertain about the causes of climate change. Note that the Pearson and deviance statistics are not significant (Pearson value = .843; Deviance value = .937). This means that the predicted values are not significantly different from the observed values, and therefore the model is a good fit.

Table 6.6: Model fitting information

Model Fitting Information						
Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	192.262	199.437	188.262			
Final	116.840	167.062	88.840	99.422	12	.000

Table 6.7: Goodness-of-fit

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	47.241	58	.843
Deviance	42.496	58	.937

Table 6.8: Pseudo R square

Pseudo R-Square	
Cox and Snell	.311
Nagelkerke	.385
McFadden	.226

The results of the regression analysis (see Appendix 4) show that only two of the predictor variables (i.e., level of education and environmental groups as a source of information about climate change) make a unique statistically significant contribution to the model. Level of education is the strongest predictor of how certain or uncertain people are about causes of climate change.

The highest level of education an individual has attained significantly predicts whether one would agree or disagree that the causes of climate change are not known (b=1.475; Wald= 13.593; *p*-value is .000). An odds ratio for individuals who indicated that they had never attended school or had only attended primary education was 4.373. This means that individuals who have never attended school or have only attended primary school are 4.373 times more likely to agree that the causes of climate change are not known than those who have a secondary or tertiary education. This is consistent with other findings of the study discussed earlier (refer to Section 5.11 and Section 5.12) that highly-educated Malawians are certain that climate change is happening and also agree that a combination of natural processes and human activities account for climate change. This means that the longer a person's period of education is, the more extensive is their knowledge about climate change and the more certain they are about climate change (see O'Connor et al., 1999; Kollmuss & Agyeman, 2002).

Whether a person has heard about climate change via an environmental group or not significantly predicts whether that individual would agree or disagree that the causes of climate change are not known (b=1.189; Wald=6.170; *p*-value is .013). Not having heard about climate change through an environmental group recorded an odds ratio of 3.285. This means that Malawians who have not heard about climate change via an environmental group are 3.285 times more likely to agree that the causes of climate change are not known than those who have. Consistent with another finding of the study discussed in Section 5.9.2, environmental groups may be considered a reliable source of information about climate change. Additionally, Malawians also trust environmental groups as a source of information about climate change (see Section 5.7). Generally, environmental groups, like scientists, are considered the most trustworthy sources of information about climate change (see Whitmarsh, 2005).

6.4.2 Belief about causes of climate change: Climate change and its impacts is the will of God

Multinomial logistic regression was performed to investigate the impact of factors on certainty/uncertainty about causes of climate change. The full model contains five independent variables (location, level of education; newspapers, formal education and the trustworthiness of village headmen as sources of information about climate change). Table 6.9

shows that the decrease in unexplained variance from the baseline model (192.581) to the final model (98.829) is 93.752 and this is significant, $p < .000$. Table 6.10 shows that the predicted values from the model do not differ significantly from observed values, meaning that the model is a good fit for the data. Table 6.11 shows that the model as a whole explains between 29.6% (Cox and Snell R square) and 35.1% (Nagelkerke R square) of the variance with respect to being certain or uncertain about the causes of climate change. The Pearson and deviance statistics are not significant (Pearson value = .327; Deviance value = .154). This means that the predicted values are not significantly different from the observed values, and therefore the model is a good fit.

Table 6.9: Model fitting information

Model Fitting Information						
Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	196.581	203.756	192.581			
Final	122.829	165.876	98.829	93.752	10	.000

Table 6.10: Goodness-of-fit

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	35.022	32	.327
Deviance	40.112	32	.154

Table 6.11: Pseudo R square

Pseudo R-Square	
Cox and Snell	.296
Nagelkerke	.351
McFadden	.190

The results of the regression analysis (see Appendix 5) show that only four of the predictor variables (i.e., location, level of education, formal education as a source of information about climate change; and trustworthiness of village headmen as source of information about climate change) make a unique statistically significant contribution to the model. Formal education as a source of information about climate change is the strongest predictor of the belief that climate change and its impact is the will of God.

Whether an individual heard about climate change through school, college or university predicts whether an individual would agree or disagree that climate change and its impact is the will of God (b=1.229; Wald=7.078; p-value is .008; odds ratio =3.419). This means that Malawians who have not heard about climate change through formal education are 3.419 times more likely to agree that climate change and its impact is the will of God than those that have heard about climate change through formal education.

Unsurprisingly, highest level of education an individual has attained is a predictor of whether one would agree or disagree that climate change and its impact is the will of God (b=1.034; Wald=7.45; *p*-value is .006; odds ratio =2.812). This means that individuals who have not had formal education or have only attended primary school are 2.812 times more likely to agree that climate change and its impact is the will of God than those who have secondary or tertiary education.

These findings suggest that formal education is crucial to a correct understanding regarding climate change. Indeed formal education is one of the reliable sources of information about climate change. People who are exposed to formal education are likely to get more extensive and accurate knowledge about environmental issues (see Kollmuss & Agyeman, 2002).

A person's place of residence is also a significant predictor of whether one would agree or disagree that climate change and its impact is the will of God (b=1.177; Wald=5.436; *p*-value is .020). The odds ratio for individuals living in rural areas was 3.243. This means that rural inhabitants are 3.243 times more likely to agree that climate change and its impact is the will of God than urban residents.

Whether people trust village headmen as source of information about climate change or not predicts whether they would agree or disagree that climate change and its impact is the will of God (b= -.899; Wald= 6.026; *p*-value is .014). An odds ratio for individuals that do not trust village headmen as a source of information about climate change was .407. This means that Malawians who trust village headmen as a source of information about climate change are 2.457 times more likely to believe that climate change and its impact is the will of God than those who do not trust village headmen as a source of information about climate change. Consistent with the findings discussed in sections 5.8.1 and 5.8.3, village headmen are trusted as sources of information by rural and urban Malawians, yet these people are the least informed about climate change (also see BBC WST, 2010). Moreover, in Malawi village headmen are regarded as custodians of tradition and have unrivalled access to rural communities.

6.4.3 Certainty/uncertainty about effects of climate change: It is uncertain what the effects of climate change will be

Multinomial logistic regression was performed to investigate the impact of factors on respondents' certainty/uncertainty about the effects of climate change. The full model contained four independent variables (location, highest level of education, formal education as a source of information about climate change and the trustworthiness of village headmen as sources of information about climate change). Table 6.12 shows that the decrease in unexplained variance from the baseline model (153.271) to the final model (65.693) is 87.578 and this is significant, $p < .000$. Table 6.13 shows that the predicted values from the model do not differ significantly from observed values, meaning that the model is a good fit for the data. Table 6.14 shows that the model as a whole explained between 28.1% (Cox and Snell R square) and 33.8% (Nagelkerke R square) of the variance with respect to certainty or uncertainty about the effects of climate change. The Pearson and deviance statistics are not significant (Pearson value = .355; Deviance value = .265). This means that the predicted values are not significantly different from the observed values, and therefore the model is a good fit (see Appendix 6).

Table 6.12: Model fitting information

Model Fitting Information						
Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	157.271	164.438	153.271			
Final	85.693	121.528	65.693	87.578	8	.000

Table 6.13: Goodness-of-fit

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	15.346	14	.355
Deviance	16.842	14	.265

Table 6.14: Pseudo R square

Pseudo R-Square	
Cox and Snell	.281
Nagelkerke	.338
McFadden	.186

The results of regression analysis (see Appendix 6) show that only one predictor variable (i.e., location) makes a unique statistically significant contribution to the model.

A person's place of residence is a significant predictor whether one would agree or disagree that it is uncertain what the effects of climate change will be (b=2.722; Wald=26.860; p-value is .000). The odds ratio for individuals indicating that they live in rural areas was 15.211. This means that rural inhabitants are 15.2 times more likely to agree that it is uncertain what the effects of climate change will be than urban residents. As we discussed in Section 5.15.3 having access to the Internet, environmental groups and formal education gives an individual the opportunity to obtain accurate information about climate change. Unfortunately, most rural inhabitants do not have access to these reliable sources of information of information about climate change, rendering them susceptible to inaccurate rumours about climate change.

As discussed in Section 5.23, people who are uncertain about what the effects of climate change will be are less likely to take personal action to address climate change. This implies that rural inhabitants in Malawi would be less likely to take personal initiatives to address climate change.

6.4.4 Belief about solving climate change: The solution to the problem of climate change rests with God

Multinomial logistic regression was also performed to investigate the impact of factors on the belief that God holds the key to solving the climate change problem. The full model contains six independent variables (location, level of education; newspapers, environmental groups, formal education and the trustworthiness of village headmen as sources of information about climate change). Table 6.15 shows that the decrease in unexplained variance from the baseline model (245.037) to the final model (108.622) is 136.415 and this is significant, $p < .000$. Table 6.16 shows that the predicted values from the model do not differ significantly from observed values, meaning that the model is a good fit for the data. Table 6.17 shows that the model as a whole explains between 40% (Cox and Snell R square) and 48.2% (Nagelkerke R square) of the variance with respect to being certain or uncertain about the causes of climate change. The Pearson and deviance statistics are not significant (Pearson value = .136; Deviance value = .664). This means that the predicted values are not significantly different from the observed values, and therefore the model is a good fit.

Table 6.15: Model fitting information

Model Fitting Information						
Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	249.037	256.212	245.037			
Final	136.622	186.843	108.622	136.415	12	.000

Table 6.16: Goodness-of-fit

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	69.922	58	.136
Deviance	52.919	58	.664

Table 6.17: Pseudo R square

Pseudo R-Square	
Cox and Snell	.400
Nagelkerke	.482
McFadden	.288

The results of the regression analysis (see Appendix 7) show that place or residence and level of education are the two predictor variables that make a unique statistically significant contribution to the model. However, it is the location of respondents that is the strongest predictor of the belief that the solution to the problem of climate change rests with God.

A respondent's place of residence significantly predicts whether one would agree or disagree that the solution of climate change rests with God (b=2.143; Wald=10.697; p-value is .001). The odds ratio for individuals indicating that they live in rural areas was 8.522. This means that rural inhabitants are 8.5 times more likely to agree that the solution to the problem of climate change rests with God than urban residents.

The highest level of education a person has attained significantly predicts whether one would agree or disagree that God holds the key to solving the climate change problem (b=1.226; Wald= 11.209; *p*-value is .001). An odds ratio for individuals who indicated that they had never attended school or had only attended primary education was 3.406. This means that individuals who have never attended school or only attended primary school are 3.406 times more likely to agree that the causes of climate change are not known than those who have a secondary or tertiary education.

6.4.5 Perception about impact of climate change on one's livelihood: My livelihood has been negatively affected by climate change

Multinomial logistic regression was performed to investigate the impact of factors on the perception that an individual's livelihood has been negatively affected by climate change. The full model contains four independent variables (i.e., location, highest level of education; newspapers and the trustworthiness of village headmen as source of information about climate change). Table 6.18 shows that the decrease in unexplained variance from the baseline model (106.299) to the final model (50.406) is 55.894 and this is significant, $p < .000$. Table 6.19 shows that the predicted values from the model do not differ significantly from observed values, meaning that the model is a good fit for the data. Table 6.20 shows that the model as a whole explains between 18.9% (Cox and Snell R square) and 26.2% (Nagelkerke R square) of variance in responses to the perception.

Table 6.18: Model fitting information

Model Fitting Information						
Model	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC	BIC	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	110.299	117.474	106.299			
Final	70.406	106.278	50.406	55.894	8	.000

Table 6.19: Goodness-of-fit

Goodness-of-Fit			
	Chi-Square	df	Sig.
Pearson	9.455	14	.801
Deviance	11.663	14	.633

Table 6.20: Pseudo R square

Pseudo R-Square	
Cox and Snell	.189
Nagelkerke	.262
McFadden	.164

The results of regression analysis (see Appendix 8) show that only one predictor variable (i.e., location) makes a unique statistically significant contribution to the model.

Affirming the hypothesis of the study (that Malawians' perceptions, beliefs and attitudes towards climate change are influenced by various factors, including how climate change has impacted on their livelihood i.e., subsistence agriculture) and consistent with chi-square analysis results discussed in Chapter Five, a person's place of residence significantly predicts whether one would agree or disagree that one's livelihood has been negatively affected by climate change (b=1.872; Wald=4.143; *p*-value is .042). An odds ratio for individuals living in rural areas was 6.503. This means that rural inhabitants are 6.5 times more likely to agree that their livelihood has been negatively affected by climate change than those who live in urban areas. Like many other countries in the Sub-Saharan African region, subsistence rain-fed agriculture underpins the livelihoods of rural inhabitants in Malawi (Kalanda-Joshua et al., 2011; Saka et al., 2013). Overdependence on rain-fed agriculture for livelihoods renders many rural Malawians vulnerable to climate change effects.

6.5 Binary logistic regression analyses: Predictors of taking personal action to address climate change

Some researchers seem to suggest that people are likely to support initiatives to address climate change if they consider the issue very serious to society, environment or even to them personally (Lorenzoni & Pidgeon, 2006). Thus it was hypothesised that individuals who are at risk of climate change effects would be more willing to take voluntary action to address climate change than those who are not. In the context of Malawi, individuals who live in rural areas are likely to take action to address climate change than those who live in urban locations. When asked “Have you ever taken any action to address climate change?” 131 respondents (45.8%) said ‘no’ and 155 respondents (54.2%) said ‘yes’. It was decided that binary logistic regression analysis be performed to assess which of the following seven predictor variables: location; level of education; the three sources of information about climate change (newspaper, formal education and environmental organisations); trustworthiness of village headmen as a source of information about climate change; and belief that climate change is caused by entirely natural processes) would predict personal initiative to address climate change.

6.6 Results of binary logistic regression analyses

The results of the regression analysis showed that the model containing seven predictors was statistically significant, X^2 (7, N=189) =22.343, p-value is .002, with 7 degrees of freedom. This means that the model was able to distinguish between repondents who took action to address climate change and those who did not (see Table 6.21). Table 6.22 shows that the model as a whole explained between 11.1% (Cox and Snell R square) and 15.2% (Nagelkerke R square) of the variance with respect to taking personal action to address climate change, and correctly classified 66.1% of the cases. The results displayed in Table 6.23 also support the model since the Hosmer-Lemeshow Test is 3.194 with a significance level of .867. The results of the regression (see Table 6.25) indicate that only two predictor variables (location and trust in village headmen as a source of information about climate change) make a unique statistically significant contribution to the model. The strongest predictor of Malawians taking personal initiative to address climate change is location, recording an odds ratio of 3.768. This means that individuals who indicate they live in rural are 3.8 times more likely to take personal action to address climate change than those who indicate they live in urban areas. Trustworthiness of village headmen as a source of information about climate change recorded an odds ratio of 0.433, indicating that individuals who do trust village headmen as a source of information about climate change are 2.31 times more likely to take personal action than those who do not trust village headmen as a source of information about climate change.

Table 6.21: Omnibus Tests of Model Coefficients

Omnibus Tests of Model Coefficients				
		Chi-square	df	Sig.
Step 1	Step	22.343	7	.002
	Block	22.343	7	.002
	Model	22.343	7	.002

Table 6.22: Model Summary

Model Summary			
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	227.855[a]	.111	.152
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.			

Table 6.23: Hosmer and Lemeshow Test

Hosmer and Lemeshow Test			
Step	Chi-square	df	Sig.
1	3.194	7	.867

Table 6.24: Classification Table

Classification Table[a]					
	Observed		Predicted		
			Q22.Have you ever taken any action to address climate change?		Percentage Correct
			No	Yes	
Step 1	Q22.Have you ever taken any action to address climate change?	No	25	46	35.2
		Yes	18	100	84.7
	Overall Percentage				66.1
a. The cut value is .500					

Table 6.25: Variables in the Equation

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Location_regression(1)	1.327	.589	5.070	1	.024	3.768	1.187	11.957
	Education(1)	-.909	.493	3.402	1	.065	.403	.153	1.059
	Q10BeliefCauseA1(1)	.583	.437	1.786	1	.181	1.792	.762	4.217
	Q5InfosourceNew(1)	.542	.472	1.316	1	.251	1.719	.681	4.337
	Q5InfosourceSch(1)	-.842	.537	2.453	1	.117	.431	.150	1.236
	Q5InfosourceEnv(1)	.376	.473	.631	1	.427	1.456	.576	3.678
	Trust_villagehead(1)	-.837	.385	4.718	1	.030	.433	.204	.922
	Constant	-.208	.553	.141	1	.707	.812		

a. Variable(s) entered on step 1: Location_regression, Education, Q10BeliefCauseA1, Q5InfosourceNew, Q5InfosourceSch, Q5InfosourceEnv, Trust_villagehead.

As I have discussed in section 5.23, Malawians who perceive that their livelihood has been negatively affected by climate change are likely to take voluntary action to address climate change. The results of binary logistic regression analysis (as shown in Figure 6.25) indicate that location of individuals is the strongest prediction of willingness to take personal action to address climate change. Malawians living in rural areas are significantly 3.8 times more likely to take personal initiative to address climate change than urban residents. This finding is consistent with previous research indicating that people who do see perceive climate change as a threat are more likely to take action to address climate change than those who do not see it as a serious problem (Leiserowitz, 2005; Brody et al., 2006; Krosnick et al., 2006; Spence et al., 2011).

Whereas the five predictor variables do influence perceptions, beliefs and attitudes towards climate change; location and trust in village headmen as a source of information about climate change are the only two predictor variables that influence individuals in taking voluntary action to address climate change. Figure 6.2 below summarises the results of the multinomial logistic regression and binary regression analyses. It is a framework depicting the influence five predictor variables have on perceptions, beliefs and attitudes towards climate change and taking voluntary action to address climate change.

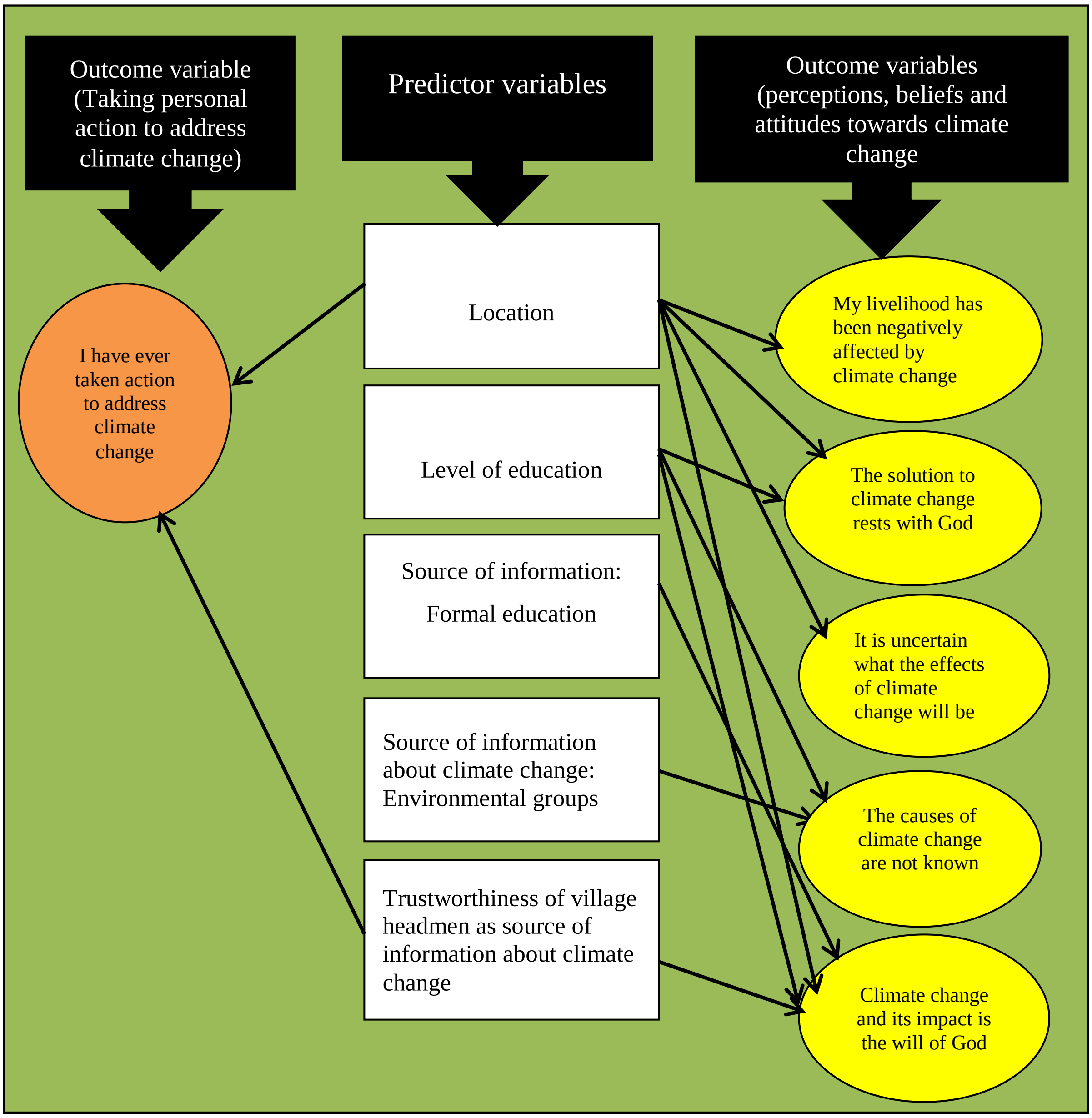

Figure 6.2: A framework depicting factors that predict Malawians' perceptions, beliefs and attitudes towards climate change

Figure 6.2 presents a summary of factors that determine Malawians' perceptions, beliefs and attitudes towards climate change and aslo their influence on taking voluntary action to address climate change. The arrows indicate the influence each of the predictor variables has on the outcome variables, and also the influence some outcome variables have on taking voluntary action to address climate change. The diagram shows that there are five predictor variables that influence Malawians' beliefs, perceptions and attitudes towards climate change. The study found that location is a predictor of five outcome variables; level of education is a predictor of three outcome variables; each of the three sources of information about climate change is a predictor of a single outcome variable; trust in village headmen as a source of information about climate change is a predictor of two outcome variables; and newspapers as a source of information about climate change is not a predictor of any belief, perception and attitude towards climate change.

Location (or place of residence): Place of residence is a predictor of five outcome variables. These variables are:

- belief that climate change and its impact is the will of God
- belief that the solution to climate change rests with God;
- how certain or uncertain a person is regarding the effects of climate change;
- whether a person perceives climate change as a threat to his or her livelihood; and
- whether an individual will take voluntary action to address climate change or not.

Level of education: Level of education is a predictor of the following:

- how certain or uncertain a person is about the causes of climate change;
- whether an individual believes that climate change and its impact is the will of God or not; and
- whether an individual believes that the solution to the problem of climate change rests with God or not.

Environmental groups as a source of information about climate change: Environmental organisations as a source of information about climate change is a predictor of how certain or uncertain a person is about the causes of climate change.

*Formal education as a source of information about climate change*Formal education as a source of information about climate change is a predictor of whether a person believes that climate change and its impact is the will of God or not.

Newspapers as a source of information about climate change: Newspapers are an important source of information about climate change in Malawi. However, the study found that the newspaper is not a predictor of beliefs, attitudes and perceptions of climate change.

Trustworthiness of village headmen as a source of information about climate change: Trust in village headmen as a source of information about climate change is a predictor of the following:

- whether an individual will believe that climate change and its impact is the will of God or not; and

- whether an individual will take a voluntary action to address climate change or not.

6.7 Conclusion

Malawians' beliefs, perceptions and attitudes towards climate change are determined by a number of factors. Regression analyses show that there are six major factors that predict Malawians' perceptions, beliefs and attitudes towards climate change. These factors are: location, highest level of education, two sources of information about climate change including environmental groups and institutions of learning (formal education), the belief that climate change is caused by entirely natural processes and the trustworthiness of village headmen as sources of information about climate change. One major finding from the analyses is that rural Malawians (whose livelihood is largely dependent on rain-fed agriculture) perceive that their livelihood has been negatively affected by climate change. This affirms the hypothesis the study set out to test.

Location of individuals is the only predictor of perception about the impact of climate change on an individual's livelihood. Rural inhabitants are 6.5 times more likely to perceive that their livelihood has been negatively affected by climate change than urban dwellers. Location also is a good predictor of beliefs that climate change and its impact is the will of God and that the solution to the problem of climate change rests with God. Location is also a predictor of how certain or uncertain people are about the effects of climate change. In summary, although rural people are less certain (than urban people) about the effects of climate change, they do believe that their livelihood has been negatively affected by climate change. And they also believe that climate change and its impact is the will of God and that God is the ultimate solution as far as matters related to climate change are concerned.

Level of education is another important predictor of perceptions, beliefs and attitudes towards climate change in Malawi. It is the strongest predictor of how certain or uncertain people are about the causes of climate change and whether the solution to the problem of climate change rests with God or not. Individuals who have less education (never attended school or only attended primary school) are 4.37 times more likely to agree that the causes of climate change are not known compared with those that have a secondary or tertiary education. The less-educated are also 3.4 times more likely to agree that the solution to the problem of climate change rests with God than those who are better educated.

Sources of information about climate change are also good predictors of Malawians' perceptions, beliefs and attitudes towards climate change. The two sources of information about climate change that predict Malawians' perceptions, beliefs and attitudes towards climate change are: institutions of learning (formal education) and environmental groups. People who have not heard about climate change through environmental groups are 3.29 times more likely to agree that the causes of climate change are not known than those who have. Formal education as a source of information about climate change is the strongest predictor of whether a person believes that climate change and its impact is the will of God. Malawians who have not learnt about climate change through formal education are 3.42 times more likely to believe that climate change and its impact is the will of God than those who have. These findings suggest that formal education and environmental groups are two crucial sources of information for the dissemination of accurate information about climate change to the public in Malawi, and that formal education remains the key to understanding of climate change issue. Additionally, more environmental groups should be engaged to disseminate climate change information to Malawians.

The trustworthiness of village headmen as a source of information about climate change is a good predictor of the belief that climate change and its impact is the will of God. Malawians who trust village headmen as a source of information about climate change are 2.46 times more likely to believe that climate change and its impact is the will of God than those who do not. It should be noted that village headmen have enormous influence among rural communities in Malawi. They are considered to be the custodians of culture and have unrivalled access to rural communities. People who trust village headmen as a source of information about climate change are also 2.31 times more likely to take personal initiative to address climate change than those who do not trust village headmen.

This chapter has provided us with models which predict Malawians' perceptions, beliefs and attitudes towards climate change in Malawi. These models also indicate wich factors are predictors of whether people are willing to take voluntary action to address climate change or not. These findings also have serious implications for public policy on climate change issues. It means policymakers and science communicators cannot conclusively allege that rural people are willing to support climate change policies. Contextual issues and the complexities about climate change (i.e., perceptions, beliefs and attitudes towards climate change) need to be understood before developing one-size-fits-all national climate change policies.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

"We have reasons to believe that if the world doesn't do anything about the emissions of greenhouse gases and the extent of climate change continues to increase, then the very social stability of human systems could be at stake" (Dr. Rajendra K. Pachauri, Chairman of the Intergovernmental Panel on Climate Change (IPCC), 2014).

7.1 Introduction

This chapter summarises the findings of three aspects: (i) Malawians' understanding of climate change, (ii) factors influencing perceptions, beliefs and attitudes of Malawians towards climate, and (iii) factors predicting perceptions, beliefs and attitudes of Malawians towards climate change. The chapter also discusses the contribution the study makes to Public Understanding of Climate Change research. Additionally, recommendations to science communicators and policymakers are made. The chapter concludes by pointing out the limitations of the study and suggesting areas that require further research.

7.2 Understanding of the climate change issue

This section summarises the findings on Malawians' understanding of climate change.

- The majority of Malawians are aware that their climate has changed over time; however, they lack proper understanding of the causes, effects and how to address climate change. Malawians have noticed remarkable changes in their climate and believe that climate change is happening. In their lay understanding of climate change issue, Malawians are also able to articulate their understanding of climate change, its causes and effects, who should take the blame for causing climate change, and how to address climate change. They also perceive climate change as a serious threat to their livelihood. The primary source of awareness about climate change among the Malawian public is personal experience. The study found that Malawians' understanding of climate change is relational. This is consistent with previous similar research by Whitmarsh (2005) conducted in the south of England. However, many Malawians living in rural areas and the less-educated Malawians lack a scientific understanding of climate change, especially regarding the causes, effects and how to mitigate climate change.

- Malawians use certain frames of reference to make sense of the climate change phenomenon. The study found that the majority of Malawians, especially rural dwellers and the less-educated, use pre-existing knowledge, beliefs and personal experience to explain the changes in their weather, climate and environment. The dominant frame of reference is "the will of God". This study also found that a significant number of respondents who indicated that climate change is caused by entirely natural processes also agree that climate change and its impacts is the will of God. Although there is an apparent contradiction between these two beliefs many Malawians hold these beliefs at the same time (refer to Leon Festinger's theory of cognitive dissonance (1957)). As discussed in Section 3.13.4.1, it seems that when some Malawians talk of "natural processes" they mean "the will of God". This finding points to the strong influence that religious beliefs have on people's understanding of climate change. Unsurprisingly, people who believe that climate change and its impacts is the will of God also believe that the solution the problem of climate change rests with God.

- The majority of Malawians, particularly those who live in rural locations, indicate that their livelihoods have been negatively affected by climate change. This finding is unsurprising when one considers that over 85% of Malawians live in rural areas and depend on rain-fed agriculture for their livelihoods. Malawi's economy is agro-based, and agriculture provides about 36% of the country's GDP. The study found that rural inhabitants are 6.5 times more likely to agree that their livelihoods have been negatively affected by climate change than urban residents.

- Where people get information about climate change has an influence on their understanding of the climate change issue. The study found that exposure to sources of information such as the Internet, environmental organisations, and institutions of learning (especially secondary schools, colleges and universities) enables people to better understand climate change science, as opposed to sources such as friends, family members, village headmen, churches and mosques. Thus, beliefs, perceptions, and attitudes towards climate change are to a large extent determined by the sources individuals use to obtain information about climate change.

- In addition to sources of information about climate change, the trustworthiness of the sources of information about climate change also influence people's understanding of the climate change issue. The study found that Malawians who trust teachers as a source of information demonstrate a correct understanding of climate change as opposed to those who trust village headmen and politicians as their sources of information about climate change. For instance, individuals who trust village headmen as their source of information about climate change are 2.5 times more likely to agree that climate change and its impact is the will of God than those who do not. Some of the sub-groups that trust village headmen are rural inhabitants, low-income earners, the less-educated and a considerable number of those who are married and divorced. Ironically, village headmen are among the least informed about climate change.

- Another key finding of the study is that education remains key to an accurate understanding of climate change. It is clear that individuals who have a secondary or tertiary education demonstrate a correct understanding of some aspects of climate change as opposed to those who have never attended school or have only a primary school education. This means that there is great need for public education about climate change in Malawi.

7.3 Factors predicting perceptions, beliefs and attitudes of Malawians towards climate change

Besides identifying factors that influence perceptions, beliefs and attitudes of Malawians towards climate change, the study developed models to predict the perceptions, beliefs and attitudes of Malawians towards climate change. Some of these factors include: location; level of education; the trustworthiness of village headmen as a source of information about climate change; and two sources of information about climate change, namely: formal education and environmental groups.

Affirming the hypothesis of the study, location is the only predictor of whether a person perceives climate change as a threat to his or her livelihood. Specifically, Malawians living in rural areas are 6.5 times more likely to agree that their livelihood has been negatively affected by climate change. Location is also a predictor of the belief that climate change and its impact is the will of God; the belief that the solution to climate change rests with God; and how certain or uncertain a person is regarding the effects of climate change.

Level of education is another important predictor of Malawians' beliefs, attitudes and perceptions of climate change. Level of education is the predictor of three outcome variables, namely: how certain or uncertain a person is about the causes of climate change; whether an individual believes that climate change and its impact is the will of God or not; and whether an individual believes that the solution to the problem of climate change rests with God or not.

The two sources of information about climate change, namely environmental groups and institutions of learning, are predictors of how certain or uncertain a person is about the causes of climate change, and whether a person believes that climate change and its impact is the will of God or not, respectively.

The trustworthiness of village headmen as a source of information about climate change is a predictor of whether an individual will believe that climate change and its impact is the will of God or not.

7.4 Recommendations to science communicators and policymakers

Malawi is not a homogeneous society. The study has found that there are different understandings of the climate change issue among the Malawian public which are reinforced by various factors. This has implications for public policy formulation as well as communicating climate change information.

One major finding from the study is that the source of information about climate change determines the kind of information about climate change people get, which ultimately influences their perceptions, beliefs and attitudes towards climate change. It is evident that urban residents have access to more reliable and trusted sources of information about climate change when compared to rural dwellers. These include scientists, environmental groups, the Internet and formal education. The most trusted source of information among rural inhabitants is the village headman. However, village headmen lack scientific understanding of climate change. It is imperative therefore to provide these village headmen with accurate information about climate for onward transmission to their communities.

Education about climate change remains the key to promoting public understanding of the issue, especially among rural communities. The findings from the study suggest that the most vulnerable groups to climate change (i.e., farmers and less income earners) are the least knowledgeable about the issue, and these are mostly Malawians in rural communities. As this study reveals, most of them rely on pre-existing knowledge, beliefs and values to make sense of climate change, which influences their perceptions, beliefs and attitudes towards the issue. The study recommends, apart from public sensitisation about climate change, the Government of Malawi, through the Ministry of Education, Science and Technology should include climate change issues in the school curricula across all levels of education. This is because formal education is the most reliable and trusted source of information about climate change. There is also a need for the non-governmental organisations to support the government in educating the public about climate change issues.

These findings suggest that while educating the public is important for a correct understanding of climate change, there is also a need to understand the contextual factors that determine Malawians' perceptions, beliefs and attitudes towards climate change. These findings affirm that the impact of climate change on livelihoods of Malawians living in rural locations influences their perceptions, beliefs and attitudes towards climate change. Additionally, the findings point to at least five aspects which could be considered priority areas for science communicators and policymakers. These are beliefs about the causes of climate change, sources of information about climate change, the trustworthiness of sources of information about climate change, levels of education and location. Each of these five aspects is fundamental to the public understanding of climate change as well as public support for initiatives to mitigate climate change in Malawi.

The findings of the study have implications for the Malawi National Climate Change policy and climate change related programmes. For instance, in order to promote climate change adaptation and mitigation for sustainable livelihoods among Malawians, there is need for the public to understand climate change issue. Enhancing public understanding of climate change in turn requires that we understand the factors that influence perceptions, beliefs and attitudes about climate change. The study has uncovered these factors. Thus, the implementation of the national climate change policy and related programmes would benefit greatly from the findings of the study. For instance, initiatives aimed at educating the rural people in Malawi about climate change would be effective if village headmen are conduits of the climate change information.

7.5 Limitations of the study

Previous studies (e.g., BBC WST, 2010; Simelton et al., 2013), have noted that the term 'climate change' is difficult to translate into a number of local African languages. For instance, Simelton and colleagues (2013) found that while in Chichewa (a language virtually spoken by the majority of Malawians) and in Chitumbuka (a language spoken by Tumbuka people most of whom live in the northern part of Malawi) the term 'climate change' (*kusintha kwa nyengo*) literally means 'weather change' (*kusintha kwa nyengo*), Setswana (a language spoken by a majority of people in Botswana) does not yet have a word for 'climate change'. This was also noted during our data collection exercise. Without elaboration, the terms 'climate' and 'weather' mean the same thing. This creates a conceptual problem when an individual would like to refer to 'climate' and not 'weather.' To get around this conceptual issue, interviewers sought clarification from participants (i.e., whether they meant 'climate' (or 'climate change') or 'weather' (or 'weather change'). These linguistic difficulties could be resolved through the intervention of our esteemed African linguists.

It is almost impossible to investigate the influence of all factors on the public perceptions of climate change in a single study. This study was limited to investigating whether Malawians' perceptions, beliefs and attitudes about climate change are influenced by the following factors: gender, age, occupation, level of education, income, livelihood, personal experience (or awareness) of climatic changes, source of information, self-reported level of knowledge, changes in daily temperature, and the negative impact of climate change on people's livelihoods. This study hypothesised that the negative impact of climate on Malawians' livelihoods significantly influences their perceptions, beliefs, and attitudes about climate change. The understanding of how this and other factors shape Malawians' perceptions, beliefs and attitudes towards climate change fills an important gap in the discourse about public understanding of climate change.

The sample size for the study (N=290) covers almost all the characteristics of the adult population in Malawi, hence, could be considered representative. However, some demographic characteristics of the sample at district level in relation to the national census data were undersampled (e.g., occupation, livelihood, ethnicity, marital status). In some cases the demographic variables (e.g., marital status and ethnicity) were too small to facilitate any analysis. In other cases, categories were combined to facilitate some statistical techniques.

Nevertheless, the results of the study are generalisable to the entire Malawian adult population simply because the sample is representative.

7.6 Future research

Research investigating factors influencing perceptions, beliefs and attitudes towards climate change has largely been informed by the critical/contextual approach. Few of these studies have utilised both qualitative and quantitative research approaches to investigate factors influencing perceptions, beliefs and attitudes towards climate change. Unfortunately, for Sub-Saharan Africa—a region most vulnerable to climate change effects because of its overdependence on rain-fed agriculture—research investigating factors influencing perceptions, beliefs and attitudes towards climate change has been lacking. This study is an attempt to close up this important gap, but more research to investigate factors influencing perceptions, beliefs and attitudes towards climate change among Africans is warranted.

The findings of the study suggest the need for further research regarding public engagement with climate change issue. The study has uncovered factors that influence perceptions, beleifs and attitudes about climate change in Malawi. Arguably, it is one thing to have correct understanding of climate change and another to behave in an environmentally sustainable manner. Thus it would be interesting to find out how the Malawian public engages with climate change, and the extent to which social actors co-ordinate on climate change issue. The key question is "How do citizens, non-governmental organisations, policymakers, and other social actors respond to climate change?"

On the basis of findings from the study, future research investigating contextual factors that influence perceptions, beliefs and attitudes towards climate change in other Sub-Saharan African countries could use an exploratory sequential mixed-method design (qualitative research building to quantitative research) so as to have a comprehensive understanding of the contextual factors. By adopting a concurrent embedded mixed-methods design the scope of the study was limited in the sense that the qualitative and quantitative data were analysed at the same time. Admittedly, the quantitative data have more weight than qualitative data. Though this helped in providing a wider perspective of public understanding of climate change in Malawi, perhaps more in-depth qualitative data and interpretation could have guided the construction of a more robust quantitative survey questionnaire.

There are a few areas that require further investigation. For instance, the study found that religion influences Malawians' perceptions, beliefs and attitudes towards climate change. However, this finding is not conclusive, and is another area that requires further research. It would also be interesting to conduct in-depth qualitative studies to understand the influence of religious teachings about the environment in general and the climate change issue in particular. Furthermore, some studies hint that gender could be a predictor of perceptions, beliefs and attitudes about climate change. This study has not validated this, but more research on whether gender predicts perceptions, beliefs and attitudes towards climate change is warranted.

The study has found that people in rural areas who trust in the village headman tend to be the most likely to take personal action on climate change. Further analysis has shown that trustworthiness of village headmen as a source of information about climate change is a predictor of whether an individual would believe that climate change and its impact is the will of God. These findings point to the need for more research on what the village headmen know about climate change and how they disseminate this information to their subjects. It would also be interesting to understand whether policymakers and communicators have engaged village headmen in matters of climate change. In relation to fostering education, here is an opportunity for the village headmen to be conduits of additional insights into climate change issue.

This study has been modest in both approach and scope. The study has used a "bottom-up" research approach (i.e., investigating the Malawian public's perceptions, beliefs and attitudes about climate change using a semi-structured interview). The study found that the majority of respondents have perceived changes in rainfall patterns and temperature over the years, however, the study has not shown that these changes correspond with meteorological data. Thus, future research should attempt to explore whether Malawians' perceptions of climate change correspond with meteorological data. The sample size for the study (i.e., 290 adult Malawians) may be considered too small to allow the performance of certain multivariate analyses, and consequently the study has not investigated all the factors that influence public perceptions, beliefs and attitudes towards climate change. It is suggested that future studies should have larger sample sizes (e.g., 500 participants) and oversampling some demographic variables such as ethinicity (i.e., Sena, Mang'anja and Tonga) and religious affiliation so that all the possible factors that could influence public understanding of climate change are investigated.

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APPENDICES

Appendix 1: Survey Questionnaire [English version]

SURVEY QUESTIONNAIRE ABOUT PUBLIC UNDERSTANDING OF GLOBAL CLIMATE CHANGE IN MALAWI

My name is Japhet Bakuwa. I am currently a registered PhD candidate at Stellenbosch University's Faculty of Arts and Social Sciences in South Africa. The aim of my research is to investigate factors that influence/shape public perceptions, attitudes and beliefs about global climate change in Malawi. In this regard, I would be very grateful if you could be a participant in this study by completing the questionnaire below. You have been chosen to complete this questionnaire because you are an adult currently living in Malawi. I would like to assure you that your identity will remain anonymous, and that your name will not be linked to the results in any way. Additionally, there are also no known risks for taking part in this study. However, you are free to withdraw your participation in this study at any point, if you feel like doing so.

Consent sought from interviewee?	YES		Place of interview: Date:
			Questionnaire No. [ ]

1. Have you experienced or noticed changes in weather, climate, and environment over the years (say, from January this year to about ten years ago?

- ❑ Yes (go to question 2)
- ❑ No (go to question 4)

2. What changes have you experienced? Please explain.

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3. Why do you think these changes are occurring? Please explain.

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……………………………………………………………………………………………………

4. Have you heard about global climate change before?

- ❑ Yes (go to question 5)
- ❑ No (go to question 6)

5. Where have you heard about global climate change? *Tick as many as apply to you*:

- ❑ Television
- ❑ Radio
- ❑ The Internet
- ❑ Newspaper
- ❑ School/college/university
- ❑ Family/friends
- ❑ Church/mosque
- ❑ Political rally
- ❑ Environmental groups
- ❑ Other (specify): ....

6. How much would you trust the following sources of information about climate change? *Please use a scale from 1 to 5, to rate each of the sources of information about climate change in the list below, where '1' means "Never trusted" and '5' "Almost always trusted"*

	Never trusted	**Seldom trusted**	**Sometimes trusted**	**Often trusted**	**Almost always trusted**
A family or friend	1	2	3	4	5
The media (i.e., television, radio, the Internet, newspaper)	1	2	3	4	5
Village headman	1	2	3	4	5
A religious leader	1	2	3	4	5
A teacher	1	2	3	4	5
Politician	1	2	3	4	5
Environmental organisation (e.g. Wildlife & Environmental Society of Malawi)	1	2	3	4	5
Scientist	1	2	3	4	5
Other: ………………………………..	1	2	3	4	5

7. How much do you know or understand about global climate change?

- ❑ I know nothing about it
- ❑ I know something about it
- ❑ I know a great deal about it

8. Do you feel you have enough information on climate change to have an opinion about it?

- ❑ Yes (go to question 9)
- ❑ No (go to question 16)
- ❑ Don't know (go to question 16)

9. If 'YES', what do you understand "climate change" to mean?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

10. Thinking about the causes of climate change, which, if any, of the following best describes your opinion?

- ❑ Entirely natural processes
- ❑ Mostly natural processes
- ❑ Natural processes and human activities
- ❑ Mostly human activities
- ❑ Entirely human activity
- ❑ I think there is no such thing as entirely human activity
- ❑ Don't know

11. When, if at all, do you think Malawi will start feeling the effects of climate change?

- ❑ We are already feeling the effects
- ❑ Next 5 years
- ❑ In the next 10 years
- ❑ In the next 20 years
- ❑ In the next 50 years
- ❑ Beyond the next 50 years
- ❑ Never
- ❑ Don't know

12. Do you think anything can be done to address climate change?

- ❑ Yes (go to question 13)
- ❑ No (go to question 14)
- ❑ Don't know (go to question 14)

13. If 'YES', what do you think can be done to address climate change?

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…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

14. In your opinion, who is responsible for causing climate change?

- ❑ All people worldwide
- ❑ You personally
- ❑ Your local community
- ❑ Developed countries
- ❑ Developing countries
- ❑ Not sure

15. To what extent are the following entities/institutions responsible for addressing climate change? *Please use a scale from 1 to 5 to rate the following, where '5' means the "To a large extent responsible" and '1' means "Not at all responsible".*

	Not at all responsible	To a limited extent responsible	Not sure	To a certain extent responsible	To a large extent responsible
Business and industry	1	2	3	4	5
You personally	1	2	3	4	5
Developed countries	1	2	3	4	5
The African Union	1	2	3	4	5
Global community	1	2	3	4	5
Developing countries	1	2	3	4	5
National governments	1	2	3	4	5
Other: ………	1	2	3	4	5

16. What additional information, if any, would you like to receive/have on climate change?

……………………………………………………………………………………………………

17. How serious do you consider the following problems **the world** is facing at the moment? *Rate each of the following problems using a scale from 1 to 5, where '1' would mean that it is "Not at all serious" and '5' would mean it is "Extremely serious".*

	Not serious at all	Not very serious	Somewhat serious	Serious	Extremely serious
Increasing world population	1	2	3	4	5
Armed conflicts	1	2	3	4	5
HIV/AIDS	1	2	3	4	5
Global climate change	1	2	3	4	5
Global economic downturn	1	2	3	4	5
Crime: theft, robbery, carjacking, burglary	1	2	3	4	5
Poverty, lack of food & drinking water	1	2	3	4	5
Air pollution	1	2	3	4	5
The spread of diseases	1	2	3	4	5
Other: …………………………..….	1	2	3	4	5

18. How serious do you consider the following problems **Malawi** is facing at the moment? *Rate each of the following problems using a scale from 1 to 5, where '1' would mean that it is "Not at all serious" and '5' would mean it is "Extremely serious".*

	Not serious at all	**Not very serious**	**Somewhat serious**	**Serious**	**Extremely serious**
Rapid population growth in Malawi	1	2	3	4	5
HIV/AIDS	1	2	3	4	5
Climate change in Malawi	1	2	3	4	5
Economic downturn	1	2	3	4	5
Crime: theft, robbery, carjacking, burglary	1	2	3	4	5
Poverty, lack of food & drinking water	1	2	3	4	5
Air pollution	1	2	3	4	5
The spread of diseases	1	2	3	4	5
Other:	1	2	3	4	5

19. How serious do you consider the following problems to you **personally**?
Rate each of the following problems using a scale from 1 to 5, where '1' would mean that it is "Not at all serious" and '5' would mean it is "Extremely serious".

	Not serious at all	**Not very serious**	**Somewhat serious**	**Serious**	**Extremely serious**
Rapid population growth in Malawi	1	2	3	4	5
HIV/AIDS	1	2	3	4	5
Climate change in Malawi	1	2	3	4	5
Economic downturn	1	2	3	4	5
Crime: theft, robbery, carjacking, burglary	1	2	3	4	5
Poverty, lack of food & drinking water	1	2	3	4	5
Air pollution	1	2	3	4	5
The spread of diseases	1	2	3	4	5
Other:	1	2	3	4	5

20. How concerned are you that climate change will negatively affect you **as an individual**? Please circle the appropriate answer. *Please use a scale from 1 to 5, to indicate your level of concern, where '1' means "not at all concerned", and '4' means "Very concerned" while '5' would mean "Don't know".*

Not at all concerned	1
Not very concerned	2
Somewhat concerned	3
Very concerned	4
Don't know	5

21. How concerned are you that climate change will negatively affect the **Malawian society**? Please circle the appropriate answer. *Please use a scale from 1 to 5, to indicate your level of concern, where '1' means "not at all concerned", and '4' means "Very concerned" while '5' would mean "Don't know".*

Not at all concerned	1
Not very concerned	2
Somewhat concerned	3
Very concerned	4
Don't know	5

22. Have you ever taken any action to address climate change?

- ❑ Yes (go to question 23)
- ❑ No (go to question 24)
- ❑ Don't know (go to question 24)

23. If 'YES', what action have you done/are you doing?

……………………………………………………………………………………………..

…………………………………………………………………………………..............

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24. How willing are you to support the implementation of a national climate change policy should the Malawi government develop it? *Please use a scale from 1 to 5, where '1' would mean "Not willing" and '5' would mean "Very willing".*

Not at all willing	1
Not very willing	2
Somewhat willing	3
Moderately willing	4
Very willing	5

25. To what extent do you agree or disagree with the following statements? *For each statement please tick the appropriate option.*

	Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
(a) Humans were meant to rule over the rest of nature					
(b) We need to preserve the environment for future generations					

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
(c) I am uncertain that climate change is happening					
(d) The causes of climate change are not known					
(e) Climate change and its impact is the will of God					
(f) Human beings are to a larger extent responsible for climate change					
(g) The seriousness of climate change is exaggerated					
(h) There is nothing I can do to slow down the effects of climate change					
(i) Developed countries should take the most blame for climate change					
(j) It is already too late to do anything about climate change					
(k) My local area/ area where I live is likely to be affected by climate change					
(l) Climate change will mostly affect areas that are far away from here					
(m) Climate change is likely to affect mostly developed countries					
(n) Changes in daily temperature of this area make me believe that climate change is happening					
(o) It is uncertain what the effects of climate change will be					
(p) The solution to the problem of climate change rests with God					
(q) Climate change does not threaten me					
(r) The concentration of greenhouse gases in the atmosphere leads to changes in climate					
(s) Some catastrophes such as floods and tsunamis make me believe that climate change is happening					
(t) My livelihood has been negatively affected by climate change					
(u) My farming has been negatively affected by climate change					

26. Which of the following best represents your livelihood? *Tick as many as apply to you*.

- ❑ Businessperson
- ❑ Farmer
- ❑ Fisherman
- ❑ Government of Malawi employee
- ❑ Private sector employee
- ❑ Parastatal employee
- ❑ A casual worker
- ❑ Other (specify): …………………………………………………………..

27. Do you think that Malawians need to worry about the impact of climate change on their livelihood?

Definitely No	1
Probably No	2
Probably Yes	3
Definitely Yes	4
Don't know	5

28. How serious do you consider the impact of climate change to be on your livelihood?

Not at all serious	1
Slightly serious	2
Somewhat serious	3
Very serious	4
Absolutely serious	5
Don't know	6

29. If your livelihood has been negatively impacted by climate change, when do you think climate change started having this effect on your livelihood?

- ❑ 1year ago
- ❑ 2-3 years ago
- ❑ 4-5 years ago
- ❑ 6-10 years ago
- ❑ Over 10 years ago
- ❑ Not sure

30. Have you done anything to address the negative impacts of climate change on your livelihood?

- ❑ Yes (go to Question 31)
- ❑ No (go to question 32)
- ❑ Not sure (go to question 32)

31. If 'YES', what is it that you have done?

……………………………………………………………………………………………

32. Why have you done nothing?

……………………………………………………………………………………………

SOCIO-DEMOGRAPHICS

Finally, we would like to know just a little about you so that we can compare the views of different people. *Please, tick the appropriate response.*

33. Age bracket: 18-24 [ ] 25-34 [ ] 35-44 [ ] 45-54 [ ] 55 and older [ ]
Prefer not to say [ ]

34. Sex: Male [ ] Female [ ]

35. Ethnicity: Chewa [ ] Ngoni [ ] Lomwe [ ] Sena [ ] Tonga [ ]
Tumbuka [ ] Yao [ ] Other (specify)**: ……………………..**

36. Marital status: Single (never married): [ ] Married [ ] Divorced [ ]
Widowed [ ]

37. Do you have children? Yes [ ] (go to question 39) No [ ]

38. Please indicate number of children: [ ]

39. Nationality: Malawian [ ] Non-Malawian [ ] (Please specify **:…………………**)

40. Highest level of academic qualification: Never attended school [ ]
PSLCE (Primary) [ ] JCE (Junior secondary) [ ]
MSCE (senior secondary school) [ ] Certificate [ ] Diploma [ ]
Degree [ ] Masters Degree [ ] Other (specify)**: ……………………**

41. Highest qualification in science-related subjected: …………………………………

42. What is your occupation? ....

43. What is your household income per month? (Malawi Kwacha/MK) (US$1=294MK)

<MK15000 [ ] 15001-30000 [ ] 30001-75000 [ ] 75001-100000 [ ]
100001-250000 [ ] 250001 - 400000 [ ] >400000 [ ]

44. Religion: Christian [ ] Muslim [ ] Other (Specify)**: ……………………………**

45. How many members of your household live in this house? [ ]

46. Please indicate by ticking which of the following best describes your political beliefs?

- ❑ Conservative
- ❑ Slightly conservative
- ❑ Neutral
- ❑ Slightly liberal
- ❑ Liberal
- ❑ Don’t know

47. How often do you attend religious activities?

- ❑ Never
- ❑ Less than one or twice a year
- ❑ Few times/year
- ❑ Weekly
- ❑ More than weekly

48. If you would like to add anything or have comments about the issues raised in this questionnaire, please write them here.

……………..

....

....

....

THANK YOU VERY MUCH FOR YOUR TIME & COMPLETING THE QUESTIONNAIRE

Appendix 2: Survey Questionnaire [Chichewa version]

MAFUNSO A KAFUKUFUKU WA ZAKUSINTHA KWA NYENGO M'MALAWI MUNO

Dzina langa ndi Japhet Bakuwa. Pakali pano ndine wophunzira maphunziro a digiri ya ung'anga (PhD) pa sukulu ya ukachenjede ya Stellenbosch ku gawo la Arts and Social Sciences mdziko la South Africa. Cholinga chachikulu cha kafukufuku ameneyu ndi kufuna kufufuza zomwe zimachititsa magulu a anthu kuona, kuganizira ndi kukhulupilira mmene amachitiramo pa nkhani za kusintha kwa nyengo m'Malawi muno. Pachifukwa ichi, ndidzakhala okondwa ngati mungatenge nawo mbali pa kafukufukuyu poyankha mafunso ali mmunsiwa. Mwasankhidwa kuti muyankhe nawo mafunsowa chifukwa inu ndinu munthu wamkulu amene akukhala kuMalawi kuno. Ndikufuna kukutsimikizirani kuti zokhudza inu sizidzadziwika kwa wina aliyense, ndipo dzina lanu silidzatchulidwa kapena kulumikizana ndi zotsatira za kafukufukuyu munjira ina iliyonse. Kuwonjezera apo palibenso zoopsa zomwe tikudziwa kuti zingakuchitikireni pochita nawo kafukufukuyu. Ngakhale izi zili chonchi, inu muli ndi ufulu woleka kuchita nawo kafukufukuyu nthawi ina iliyonse yomwe inu mwafuna.

<table>
<tr><td rowspan="2">Kodi woyankha mafunso wavomereza kutenga nawo mbali?</td><td>INDE</td><td></td><td>Malo ofunsira ndi kuyankhira mafunso</td><td></td></tr>
<tr><td></td><td></td><td colspan="2">Nambala ya kabuku ka mafunso [ ]</td></tr>
</table>

1. Kodi mwaonapo kapena kudziwapo za kusintha kwa mmene kunja kukuchera, nyengo ndi zachilengedwe mzaka (mwachitsanzo, kuchokera January chaka chino mpaka zaka pafupifupi khumi) zapitazo?

- ❑ Eya (pitani kufunso la nambala 2)
- ❑ Ayi (pitani ku funso la nambala 4)

2. Ndi kusintha kotani kumene mwakuona? Chonde fotokozani.

……………………………………………………………………………………………

……………………………………………………………………………………………

3. Mukuganiza kuti ndi chifukwa chiyani kusinthaku kukuchitika? Chonde fotokozani.

…………………………………………………………………………………………...

....

4. Kodi munamvapo kale za kusintha kwa nyengo padziko lapansi?
- ❑ Eya (pitani ku funso la nambala 5)
- ❑ Ayi (pitani ku funso la nambala 6)

5. Kodi ndikuti kumene munamvapo za zakusintha kwanyengoku? *Chongani zonse zimene zikugwirizana ndi zomwe mukudziwa:*

- ❑ Pa wailesi ya kanema
- ❑ Pa wailesi
- ❑ Pa intaneti
- ❑ Munyuzipepala
- ❑ Kusukulu/ kukoleji/ kusukulu ya ukachenjede
- ❑ Kwa abale/Kwa anzanu
- ❑ Kutchalitchi/kumzikiti
- ❑ Pa msonkhano wa ndale
- ❑ Mmagulu owona za nyengo
- ❑ Kwina (tchulani): ....

6. Kodi mungakhulupilire motani njira zopezera mauthenga izi pa nkhani za kusintha kwa nyengo? *Chonde gwiritsani ntchito mlingo mwapatsidwa wochokera 1 mpaka 5, kuti muyenereze za kukhulupirika kwa njirazi pa nkhani za kusintha kwa nyengo. Nambala 1 ikutanthauza kuti "yosakhulupirika nthawi zonse" ndipo nambala 5 ikutanthauza kuti "yokhulupirika nthawi zonse"*

	Yosakhulupirika nthawi zonse	**Yokhulupirika mwa patalipatali**	**Yokhulupirika nthawi zina**	**Yokhulupirika nthawi zambiri**	**Yokhulupirika nthawi zonse**
Wachibale kapena mnzanu	1	2	3	4	5
Njira zofalitsira nkhani (monga, wailesi ya kanema, wailesi, intaneti, nyuzipepala)	1	2	3	4	5
Amfumu	1	2	3	4	5
Atsogoleri a mpingo	1	2	3	4	5
Aphunzitsi	1	2	3	4	5
Andale	1	2	3	4	5
Bungwe la za nyengo monga la Wildlife and Environmental Society of Malawi)	1	2	3	4	5
A sayansi	1	2	3	4	5
Njira zina:	1	2	3	4	5

7. Kodi mukudziwa kapena kumvetsa mochuluka bwanji pa nkhani za kusintha kwa nyengo?

- ❑ Palibe chimene ndidziwa za nkhaniyi
- ❑ Ndimadziwapo zingapo za nkhaniyi
- ❑ Ndimadziwa zambiri za nkhaniyi

8. Kodi mukuganiza kuti mukudziwa zambiri za nkhaniyi koti mutha kuyankhulapo maganizo anu pa nkhani ya zakusintha kwa nyengo

- ❑ Eya (pitani ku funso la nambala 9)
- ❑ Ayi (pitani ku funso la nambala 16)
- ❑ Simukudziwa kanthu (pitani ku funso la nambala16)

9. Ngati mwati 'Eya' mukuganiza kuti mawu akuti 'kusintha kwa nyengo' amatanthauza chiyani?

……………………………………………………………………………………………

……………………………………………………………………………………………

10. Mukaganiza za zoyambitsa kusintha kwa nyengo, ndi mfundo ziti mwa izi zomwe zikugwirizana bwino ndi maganizo anu?

- ❑ Ndimmene chilengedwe chilili
- ❑ Kwakukulu ndi chilengedwe chabe
- ❑ Ndi chilengedwe komanso zochita za anthu
- ❑ Kwakukulu ndi chifukwa cha zochita za anthu
- ❑ Ndichifukwa cha zochita za anthu
- ❑ Ndikuganiza kuti mfundo yakuti ndi chifukwa cha zochita za anthu zokha siyolondola
- ❑ Sindikudziwa

11. Ndiliti, ngati zingatero, pamene mukuganiza kuti dziko la Malawi lidzayamba kumva kapena kuona zotsatira za kusintha kwa nyengo?

- ❑ Tikuzimva kale zotsatira zake
- ❑ Mzaka zisanu zikudzazo
- ❑ Mzaka khumi zikudzazo
- ❑ Mzaka makumi awiri zikudzazo
- ❑ Mzaka makumi asanu zikudzazo
- ❑ Mzaka zopitilira makumi asanu zikudzazo
- ❑ Sizidzachitika
- ❑ Sindikudziwa

12. Kodi mukuganiza kuti ndi zotheka kuchitapo kanthu pa nkhani yolimbana ndi vuto la kusintha kwa nyengo?

- ❑ Eya (pitani ku funso la nambala 13)
- ❑ Ayi (pitani ku funso la nambala 14)
- ❑ Sindikudziwa (pitani ku funso la nambala 14)

13. Ngati mwati 'Eya', mukuganiza kuti chichitike ndi chiyani pakulimbana ndi vuto la kusintha kwa nyengo?

…………………………………………………………………………………………………….

14. Mmaganizo anu, ndi ndani amene akuchititsa vuto la kusintha kwa nyengo?

- ❑ Anthu onse dziko lonse la pansi
- ❑ Inu nomwe
- ❑ Anthu a mdera lanu
- ❑ Maiko olemera
- ❑ Maiko amene akulemera kumene
- ❑ Sindikudziwa bwinobwino

15. Ndi udindo wochuluka bwanji umene magulu kapena mabungwe otsatirawa ali nawo pa kulimbana ndi vuto la kusintha kwa nyengo? *Chonde gwiritsani ntchito mlingo mwapatsidwawu wochokera 1 mpaka 5, pamene nambala 5 ikuimira "akukhudzidwa kwambiri" ndipo nambala 1 ikuimira "Sakukhudzidwa ndi pang'ono pomwe".*

	Sakukhudzidwa ndi pang'ono pomwe	**Akukhudzidwa pang'ono pokha**	**Mukukaika**	**Akukhudzidwa ko ndithu**	**Akukhudzidwa kwambiri**
Mabizinesi ndi makampane	1	2	3	4	5
Ine pa ndekha	1	2	3	4	5
Mayiko olemera	1	2	3	4	5
Bungwe la mgwirizano wa maiko amuAfrika (The African Union)	1	2	3	4	5
Anthu onse a dziko la pansi	1	2	3	4	5
Maiko amene akukwera kumene	1	2	3	4	5
Mayiko	1	2	3	4	5
Zina…………	1	2	3	4	5

16. Ndi uthenga wowonjezera uti umene mungakonde kuti mulandire kapena kukhala nawo pa nkhani za kusintha kwa nyengo?

…………………………………………………………………………………………………….

……………………………………………………………………………………………………

17. Kodi mukuona ngati mavuto otsatirawa ndi akulu bwanji amene dziko likukumana nawo pakali pano? *Liikeni vuto lililonse pa gulu la mavuto otsatirawa pa muyezo wa pakati pa 1 mpaka 5, pamene nambala 1 ikutanthauza kuti "vuto silalikulu konse' ndipo nambala 5 ikutanthauza kuti vuto "Ndi lalikulu zedi".*

	Sivuto lalikulu ndi pang'ono pomwe	**Sivuto lalikulu kwambiri**	**Ndi vuto lalikulupo ndithu**	**Ndivuto lalikulu**	**Ndi vuto lalikulu kwambiri**
Kupitilira kwa kuchulukana kwa anthu	1	2	3	4	5
Nkhondo	1	2	3	4	5
HIV/AIDS	1	2	3	4	5
Kusintha kwa nyengo dziko lonse la pansi	1	2	3	4	5
Kulowa pansi kwa chuma cha dziko lonse la pansi	1	2	3	4	5
Umbanda: kuba, umbava wa mfuti, kuba magalimoto, kuthyola nyumba pofuna kuba	1	2	3	4	5
Umphawi, kusowa kwa chakudya ndi madzi akumwa	1	2	3	4	5
Kuonongeka kwa mpweya	1	2	3	4	5
Kufala kwa matenda	1	2	3	4	5
Zina………..........	1	2	3	4	5

18. Kodi mavuto otsatirawa amene dziko la Malawi likukumana nawo pakali pano ndi akulu bwanji? *Nenani kukula kwa vuto lililonse pa mavuto otsatirawa pogwiritsa ntchito mlingo wa 1 mpaka 5 omwe mwapatsidwa, pamene nambala 1 ikutanthauza "Silalikulu nkomwe" ndipo nambala 5 ikuthanthauza kuti "lalikulu kwambiri".*

	Sivuto lalikulu ndi pang'ono pomwe	**Sivuto lalikulu kwambiri**	**Ndi vuto lalikulupo ndithu**	**Ndivuto lalikulu**	**Ndi vuto lalikulu kwambiri**
Kuchulukana kwa anthu kochitika mofulumira zedi ku Malawi	1	2	3	4	5
HIV/AIDS	1	2	3	4	5
Kusintha kwa nyengo ku Malawi	1	2	3	4	5
Kulowa pansi kwa chuma	1	2	3	4	5
Umbanda: kuba, umbava wa mfuti, kuba magalimoto, kuthyola nyumba pofuna kuba	1	2	3	4	5
Umphawi, kusowa kwa chakudya ndi madzi akumwa	1	2	3	4	5
Kuonongeka kwa mpweya	1	2	3	4	5
Kufala kwa matenda	1	2	3	4	5
Zina: ……………	1	2	3	4	5

19. Kodi mavuto otsatirawa ndi akulu bwanji kwa inu eni? *Nenani kukula kwa vuto lililonse pa mavuto otsatirawa pogwiritsa ntchito mlingo wa 1 mpaka 5 omwe mwapatsidwa, pamene nambala 1 ikutanthauza "Silalikulu nkomwe" ndipo nambala 5 ikuthanthauza kuti "lalikulu kwambiri".*

	Sivuto lalikulu ndi pang'ono pomwe	**Sivuto lalikulu kwambiri**	**Ndi vuto lalikulupo ndithu**	**Ndivuto lalikulu**	**Ndi vuto lalikulu kwambiri**
Kuchulukana kwa anthu kochitika mofulumira zedi ku Malawi	1	2	3	4	5
HIV/AIDS	1	2	3	4	5
Kusintha kwa nyengo ku Malawi	1	2	3	4	5
Kulowa pansi kwa chuma	1	2	3	4	5
Umbanda: kuba, umbava wa mfuti, kuba magalimoto, kuthyola nyumba pofuna kuba	1	2	3	4	5
Umphawi, kusowa kwa chakudya ndi madzi akumwa	1	2	3	4	5
Kuonongeka kwa mpweya	1	2	3	4	5
Kufala kwa matenda	1	2	3	4	5
Zina:…………..	1	2	3	4	5

20. Kodi ndinu okhudzidwa bwanji kuti kusintha kwa nyengo kudzakusokonezerani moyo wanu, inu panokha? Chonde zungulizani yankho lomwe mugwirizana nalo. *Gwiritsani ntchito mulingo wa pakati pa 1 mpaka 5, kuti muonetse kukula kwa kukhudzidwa kwanu pamene nambala 1 ikutanthauza "sindikukhudzidwa ndi pang'ono pomwe" ndipo nambala 4 ikutanthauza "ndikukhudzidwa kwambiri" ndipo nambala 5 itanthauza "sindikudziwa"*

Sindikukhudzidwa ndi pang'ono pomwe	1
Sindikukhudzidwa kwambiri	2
Ndikukhudzidwa pang'ono	3
Ndikukhudzidwa kwambiri	4
Sindikhudziwa	5

21. Kodi ndinu okhudzidwa bwanji kuti kusintha kwa nyengo kudzasokoneza mtundu wa a Malawi? Chonde zungulizani yankho lomwe mukugwirizana nalo. *Gwiritsani ntchito mlingo woyambira 1 mpaka 5 kuti muonetse kukula kwa nkhawa zanu, pamene nambala 1 ikutanthauza "sindikukhudzidwa ngakhale pang'ono" ndipo nambla 4 ikutanthauza kuti "ndikukhudzidwa kwambiri" ndipo nambala 5 ikutanthauza kuti "Sindikudziwa"*

Sindikukhudzidwa ngakhale pang'ono	1
Sindikukhudzidwa kwambiri	2
Ndikukhudzidwa pang'ono	3
Ndikukhudzidwa kwambiri	4
Sindikudziwa	5

22. Kodi munachitapo kanthu pakulimbana ndi vuto la kusintha kwa nyengo?

- ❑ Eya (pitani ku funso la nambala 23)
- ❑ Ayi (pitani ku funso la nambala 24)
- ❑ Sindikudziwa (pitani ku funso la nambala 24)

23. Ngati mwati 'Eya' ndi chiyani chimene munachitapo kapena mukuchitapo polimbana ndi vuto la kusintha kwa nyengo?

……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………..

24. Ndinu okonzeka bwanji kuti muthandizire kukhazikitsa ndondomeko ya dziko la malawi yofuna kulimbana ndi vuto la kusintha kwa nyengo ngati dziko la Malawi lingakonze ndondomeko yoteleyi? *Chonde gwiritsani ntchito mlingo woyambira 1 mpaka 5, pamene nambala 1 ikutanthauza "Simukufuna ngakhale pang'ono" ndipo nambala 5 ikutanthauza "mukufuna kwambiri".*

Simukufuna ngakhale pang'ono	1
Simukufuna kwambiri	2
Mukufuna pang'ono chabe	3
Mukufuna	4
Mukufuna kwambiri	5

25. Kodi mukugwirizana kapena kutsutsana ndi mfundo zotsatirazi kwambiri bwanji? *Pa mfundo iliyonse chongani yankho lomwe mukugwirizana nalo*

	Ndikutsutsana nazo kwambiri	**Ndikutsutsana nazo**	**Sindikugwirizana nazo kapena kutsutsana nazo**	**Ndikugwirizana nazo**	**Ndikugwirizana nazo kwambiri**
(a) Anthu anawapanga kuti alamulire zolengedwa zonse					
(b) Tiyenera kusamalira za chilengedwe kuti mibadwo ikubwerayo idzazipeze					
(c) Sindikudziwa kwenikweni ngati kusintha kwa nyengo kukuchitikadi					
(d) Zomwe zimachititsa kusintha kwa nyengo sizimadziwika					
(e) Kusintha kwa nyengo ndi zotsatira zake ndi chikonzero cha Mulungu					

	Ndikutsutsana nazo kwambiri	**Ndikutsutsana nazo**	**Sindikugwiriza na nazo kapena kutsutsana nazo**	**Ndikugwiriza na nazo**	**Ndikugwiriza na nazo kwambiri**
(f) Anthu ali ndi mbali yaikulu pakuchititsa kusintha kwa nyengo					
(g) Kukula kwa vuto la kusintha kwa nyengo kukukokomezedwa					
(h) Palibe chimene ndingachite pofuna kuchepetsa zotsatira za kusintha kwa nyengo					
(i) Maiko olemera ayenera kuvomereza kuti ndiwo akuchititsa kusintha kwa nyengo					
(j) Tinachedwa kale kwambiri kuti tichitepo kanthu pa nkhani ya kusintha kwa nyengo					
(k) Ndizachidziwikire kuti dera limene ndimakhala lidzakhudzidwa ndi vuto la kusintha kwa nyengo					
(l) Kusintha kwa nyengo kudzakhudza kwambiri madera amene ali kutali ndi kwathu kuno					

	Ndikutsutsana nazo kwambiri	Ndikutsutsana nazo	Sindikugwiriza na nazo kapena kutsutsana nazo	Ndikugwiriza na nazo	Ndikugwiriza na nazo kwambiri
(m) Kusintha kwa nyengo kukuoneka kuti kudzakhudza kwambiri maiko olemera					
(n) Kusinthasintha kwa mmene kukumatenthera tsiku ndi tsiku mudera lathu lino kumandichititsa kukhulupilira kuti kusintha kwa nyengo kukuchitikadi					
(o) Sizikudziwika bwino bwino kuti zotsatira za kusintha kwa nyengo zidzakhala zotani					
(p) Njira yothetsera vuto la kusintha kwa nyengo ili mmanja mwa Mulungu					
(q) Kusintha kwa nyengo sikumandiopsa					
(r) Kuungana kwa mpweya wosunga mtukutira kuthambo kukuchititsa kusintha kwa nyengo					
(s) Ngozi za chilengedwe monga kusefukira kwa madzi ndi matsunami					

	Ndikutsutsana nazo kwambiri	Ndikutsutsa na nazo	Sindikugwiriza na nazo kapena kutsutsana nazo	Ndikugwiriza na nazo	Ndikugwiriza na nazo kwambiri
kumandichititsa ine kukhulupirira kuti kusintha kwa nyengo kukuchitikadi					
(t) Njira zopezera zofuna za moyo wanga zasokonekera kamba ka kusintha kwa nyengo					
(u) Ulimi wanga wasokonekera kaamba ka kusintha kwa nyengo					

26. Ndi njira ziti mwa njira mwapatsidwazi zimene zikuimira njira zomwe mumapezera zofuna za moyo wanu? *Chongani zonse zomwe mukugwirizana nazo*

- ❑ Ndinu a bizinesi
- ❑ Mlimi
- ❑ Msodzi
- ❑ Ogwira ntchito ya boma
- ❑ Ogwira ntchito mmakampani oti siaboma
- ❑ Ogwira ntchito mkampani kapena bungwe la boma
- ❑ Mumagwira maganyu
- ❑ Zina (zitchuleni): ………………………………………………………..

27. Kodi mukuganiza kuti a Malawi ayenera kudandaula za zotsatira za kusintha kwa nyengo pa njira zomwe amapezera zofuna za moyo wawo?

Ayi sayenera kutero	1
Mwina sayenera kutero	2
Mwina akuyenera kutero	3
Akuyenera kutero	4
Sindikudziwa	5

28. Kodi mukuganiza kuti vuto la kusintha kwa nyengo lili ndi zotsatira zochuluka bwanji?

Silalikulu ndi pang'ono pomwe	1
Lalikulu pang'ono	2
Ndi lalikulupo	3
Ndi lalikulu kwambiri	4
Ndi lalikulu zedi	5
Sindikudziwa	6

29. Ngati njira zopezera zofuna za moyo wanu zasokonekera kamba ka vuto la kusintha kwa nyengo, mukuganiza kuti zimenezi zinayamba liti?

- ❑ Chaka chimodzi chapitacho
- ❑ Zaka ziwiri kapena zitatu zapitazo
- ❑ Zaka zinayi kapena zisanu zapitazo
- ❑ Zaka 6 mpaka khumi zapitazo
- ❑ Kuposera zaka khumi zapitazo
- ❑ Sindikudziwa bwinobwino

30. Kodi mwachitapo kanthu pofuna kulimbana ndi mavuto odza kamba ka zotsatira za kusintha kwa nyengo pa njira zopezera zofuna za moyo wanu?

- ❑ Eya (pitani ku funso la nambala 31)
- ❑ Ayi (pitani ku funso la nambala 32)
- ❑ Sindikudziwa (pitani ku funso la nambala 32)

31. Ngati mwati 'Eya' ndi chiyani chimene mwachitapo?

…………………………………………………………………………………………………

32. Ndi chifukwa chiyani simunachitepo kanthu?

…………………………………………………………………………………………………

ZOKHUDZA CHIWERENGERO CHA ANTHU OCHITA NAWO KAFUKUFUKU

Pamapeto pake timafuna titadziwako pang'ono za inu ndi cholinga choti tithe kufananitsa maganizo a anthu osiyanasiyana. *Chonde chongani yankho lolondola*

33. Gulu la zaka: 18-21 [ ] 25-34 [ ] 35-44 [ ] 45-54 [ ]

55 ndi kuposera apo [ ] Simukufuna kunena [ ]

34. Ndinu mwamuna kapena Mkazi: Mwamuna [ ] Mkazi [ ]

35. Mtundu: Chewa [ ] Ngoni [ ] Lomwe [ ] Sena [ ] Sena [ ]

Tonga [ ] Tumbuka [ ] Yao [ ] Wina (utchuleni)**:……………….**

36. Ndinu wa pabanja: Ndili ndekha (sindinakwatirepo/sindinakwatiwepo): [ ]
Okwatiwa/Okwatira[ ] Banja linatha [ ] Wamasiye [ ]

37. Muli ndi ana? Eya [ ] (pitani ku funso la nambala 38) Ayi [ ] (pitani ku funso la nambala 39)

38. Chonde lembani chiwerengero cha ana anu[ ]

39. Umbadwa: Mmalawi[ ] Sindine Mmalawi [ ] (Chonde fotokozani **:………………**)

40. Pamene munalekeza ndi maphunziro:

Sindinapite ku sukulu [ ] PSLCE (Pulayimale sukulu) [ ] JCE (Junior secondary) [ ] MSCE (senior secondary school) [ ] Certificate [ ] Diploma [ ] Degree [ ] Masters Degree [ ] Ena (fotokozani)**: ………………………………**

41. Maphunziro apamwamba kwambiri pa phunziro la sayansi: ……………………….

42. Mumagwira ntchito yanji ?..

43. Kodi mumapeza ndalama zingati pa mwezi (Malawi Kwacha/MK)

(US$1=294MK)

<MK15000 [ ] 15001-30000 [ ] 30001-75000 [ ] 75001-100000 [ ]

100001-250000 [ ] 250001 - 400000 [ ] >400000 [ ]

44. Chipembedzo: Chikhristu [ ] Chisilamu [ ] Zina(chitchuleni)**:………………………**

45. Ndi anthu angati a m banja mwanu amene mumakhala nawo mnyumba yapanopa?
[ ]

46. Chonde chongani mfundo yomwe ikufotokoza maganizo anu pa ndale?

- ❑ Sindifuna zosinthasintha
- ❑ Ndimalolera kusintha pang'ono
- ❑ Ndili pakatikati
- ❑ Ndine omasuka pang'ono
- ❑ Ndine omasuka
- ❑ Sindikudziwa

47. Kodi mumapita kangati kuzochitika za mapemphero?

- ❑ Sindipitako
- ❑ Kosapitilira kamodzi kapena kawiri pachaka
- ❑ Kangapo kokha pa chaka
- ❑ Sabata iliyonse
- ❑ Kuposa kamodzi pa sabata

48. Ngati mukufuna kuwonjezerapo zina ndi zina pa nkhani zanenedwa mmafunsowa, chonde zilembeni mmunsimu.

……………..

....

ZIKOMO KWAMBIRI KAMBA KA NTHAWI YANU NDI KUYANKHA MAFUNSOWA.

Appendix 3: Survey Questionnaire Codebook

Description of variable	SPSS variable name	Coding instructions
Identification number	id	Number assigned to each survey questionnaire
Location of interview	location	1=Rural 2=Urban
Date of interview	date	For example 280213
Name of interviewer	interviewer	1=FM 2=MK 3=FC 4=DM 5=YC 6=KK 7=JB 8=Anonymous respondent
Region of interview	region	1=Southern Region 2=Central Region 3=Northern Region
District of interview	district	1=Blantyre 2=Chikhwawa 3=Lilongwe 4=Kasungu 5=Ntcheu 6=Mulanje 7=Salima 8=Nkhata Bay 9=Mzimba 10=Zomba 11=Mangochi
City	City	1=Blantyre 2=Lilongwe 3=Mzuzu 4=Zomba
Rural district	District_Rural	1=Ntcheu 2=Salima 3=Nkhata Bay 4=Mangochi 5=Mzimba 6=Blantyre 7=Mulanje 8=Zomba 9=Kasungu 10=Chikhwawa 11=Lilongwe
1. People's awareness of changes in weather, climate and environment	Q1awareness1	0=No 1=Yes
2. Changes experienced	Q2awareness2_Temperature	0= No 1=Yes

	Q2awareness2_Erraticrainfall	0=No 1=Yes
	Q2awareness2_Weatherandseasons	0=No 1=Yes
	Q2awareness2_Drought	0=No 1=Yes
	Q2awareness2_Flooding	0=No 1=Yes
	Q2awareness2_Lateonsetrainfall	0=No 1=Yes
	Q2awareness2_Dryingwaterbodies	0=No 1=Yes
	Q2awareness2_Diseases	0=No 1=Yes
	Q2awareness2_poorharvests	0=No 1=Yes
	Q2awareness2_Environdegradation	0=No 1=Yes
	Q2awareness2_Windpatterns	0=No 1=Yes
	Q2awareness2_Other	0=No 1=Yes
3. People's understanding of causes of changes	Q3understandingcause_Naturalprocesses	0=No 1=Yes
	Q3understandingcause_Badpractices	0=No 1=Yes
	Q3understandingcause_Greenhousegases	0=No 1=Yes
	Q3understandingcause_Deforestation	0=No 1=Yes
	Q3understandingcause_Pollution	0=No 1=Yes
	Q3understandingcause_Depletedozonelayer	0=No 1=Yes
	Q3understandingcause_WillofGod	0=No 1=Yes
	Q3understandingcause_Overpopulation	0=No 1=Yes
	Q3understandingcause_Lackoftrees	0=No 1=Yes

	Q3understandingcause_Apocalypse	0=No 1=Yes
	Q3understandingcause_Globalwarming	0=No 1=Yes
	Q3understandingcause_Other	0=No 1=Yes
	Q3understandingcause_Idontknow	0=No 1=Yes
4. People's general awareness	Q4awareness3	0=No 1=Yes
5. (a). Information source: Television	Q5InfosourceTV	0=No 1=Yes
(b). Information source: Radio	Q5InfosourceRad	0=No 1=Yes
(c). Information source: The Internet	Q5InfosourceInte	0=No 1=Yes
(d). Information source: Newspaper	Q5InfosourceNew	0=No 1=Yes
(e). School/College/University	Q5InfosourceSch	0=No 1=Yes
(f). Information source: Family/Friends	Q5InfosourceFam	0=No 1=Yes
(g). Information source: Church/Mosque	Q5InfosourceChur	0=No 1=Yes
(h). Info source: Political rally	Q5InfosourcePol	0=No 1=Yes
(i). Info source: Environmental groups	Q5InfosourceEnv	0=No 1=Yes
(j). Information source: Formal forums	Q5InfosourceFormal	0=No 1=Yes
(k). Info source: Informal forums	Q5InfosourceInformal	0=No 1=Yes

(l). Agricultural Extension Workers	Q5InfosourceAEWorkers	0=No 1=Yes
(m). Non-governmental Organisations	Q5InfosourceNGOs	0=No 1=Yes
(n). Information source: Other	Q5InfosourceOther	0=No 1=Yes
6. (a). Trust in info source: Family/friends	Q6trust1a	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(b). Trust in info source: the media	Q6trust1b	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(c). Trust in info source: village headman	Q6trus1c	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(d). Trust in info source: religious leader	Q6trust1d	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(e). Trust in info source: teacher	Q6trust1e	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(f). Trust in info source: politician	Q6trust1f	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(g). Trust in info source: environmental organisations	Q6trust1g	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(h). Trust in info source: scientist	Q6trust1h	1=Never trusted 2=Seldom trusted 3=Sometimes trusted 4=Often trusted 5=Almost always trusted
(i). Trust in source of info about	Q6trust1i	1=Never trusted 2=Seldom trusted 3=Sometimes trusted

climate change: Other		4=Often trusted 5=Almost always trusted
7. Self-reported level of knowledge of understanding of climate change issue	Q7selfreportedlevelknow	0=I know nothing about it 1=I know something about it 2=I know a great deal about it
8. Self-reported feeling of adequacy of info to make an opinion	Q8selfreportedadeqinfo	0=No 1=Don't know 2=Yes
9. People's understanding of the term	Q9Definition	1=Changes in average weather conditions over a long period of time 2=Changes in weather pattern 3=Changes in rainfall pattern, temperature and soil fertility (or crop yield) 4=Changes in weather/climate and surrounding environment 5=Changes in temperature 6=Changes in rainfall pattern 7=Changes in the surrounding environment 8=Changes in timing of rainfall 9=Changes in rainfall pattern and movement of wind 10=Changes in rainfall pattern and spread of sicknesses and diseases 11=Changes in rainfall pattern and temperature 12=Other

10. (a). Understanding of the causes of climate change: Entirely natural processes	Q10Cause1	0=No 1=Yes
(b). Understanding of the causes of climate change: Mostly natural processes	Q10Cause2	0=No 1=Yes
(c). Understanding of the causes of climate change: Natural processes and human activities	Q10Cause3	0=No 1=Yes
(d). Understanding of the causes of climate change: Mostly human activities	Q10Cause4	0=No 1=Yes
(e). Understanding of the causes of climate change: Entirely human activity	Q10Cause5	0=No 1=Yes
(f). Understanding of the causes of climate change: I think there is no such thing as entirely human activity	Q10Cause6	0=No 1=Yes
(g). Understanding of the causes of climate change: Don't know	Q10Cause7	0=No 1=Yes
11. The time Malawi will start feeling the effects of climate change	Q11time	1=We are already feeling the effects 2=Next 5 years 3=In the next 10 years 4=In the next 20 years 5=In the next 50 years 6=Beyond the next 50 years 7=Never 8=Don't know
12. Whether anything can be done to address climate change	Q12action	0=No 1=Don't know 2=Yes

13. Action to be taken	Q13actiontobetaken_Plantingtrees	0=No 1=Yes
	Q13actiontobetaken_Avoiddeforestation	0=No 1=Yes
	Q13actiontobetaken_Avoidpollution	0=No 1=Yes
	Q13actiontobetaken_Publicawareness	0=No 1=Yes
	Q13actiontobetaken_Praying	0=No 1=Yes
	Q13actiontobetaken_Goodpractices	0=No 1=Yes
	Q13actiontobetaken_Irrigation	0=N0 1=Yes
	Q13actiontobetaken_Avoidgasemissions	0=No 1=Yes
	Q13actiontobetaken_Controlppngrowth	0=No 1=Yes
	Q13actiontobetaken_Other	0=No 1=Yes

14. (a). Responsibility for causing climate change: All people	Q14RespPeople	
(b). Responsibility for causing climate change: You	Q14RespYou	0=No 1=Yes
(c). Responsibility for causing climate change: local community	Q14RespComm	0=No 1=Yes
(d). Responsibility for causing climate change: Developed countries	Q14RespDev	0=No 1=Yes
(e). Responsibility for causing climate change: Developing countries	Q14RespDevng	0=No 1=Yes
(f). Responsibility for causing climate change: Not sure	Q14RespNotsure	0=No 1=Yes

(g). Responsibility for causing climate change: God	Q14RespGod	0=No 1=Yes
(h). Responsibility for causing climate change: Other	Q14RespOther	0=No 1=Yes
15. (a). The extent of responsibility for addressing climate change: Business and industry	Q15responsibilityBus	1=Not at all responsible 2=To a limited extent responsible 3=Not sure 4=To a certain extent responsible 5=To a large extent responsible
(b). The extent of responsibility for addressing climate change: You personally	Q15responsibilityPers	1=Not at all responsible 2=To a limited extent responsible 3=Not sure 4=To a certain extent responsible 5=To a large extent responsible
(c). The extent of responsibility for addressing climate change: Developed countries	Q15responsibilityDev	1=Not at all responsible 2=To a limited extent responsible 3=Not sure 4=To a certain extent responsible 5=To a large extent responsible
(d). The extent of responsibility for addressing climate change: The African Union	Q15responsibilityAU	1=Not at all responsible 2=To a limited extent responsible 3=Not sure 4=To a certain extent responsible 5=To a large extent responsible
(e). The extent of responsibility for addressing climate change: Global community	Q15responsibilityGC	1=Not at all responsible 2=To a limited extent responsible 3=Not sure 4=To a certain extent responsible 5=To a large extent responsible
(f). The extent of responsibility for addressing climate change: developing countries	Q15responsibilityDevng	1=Not at all responsible 2=To a limited extent responsible 3=Not sure 4=To a certain extent responsible 5=To a large extent responsible
(g). The extent of responsibility for addressing climate change: National governments	Q15responsibilityGovts	1=Not at all responsible 2=To a limited extent responsible 3=Not sure 4=To a certain extent responsible

		5=To a large extent responsible
16. Additional information about climate change required	Q16addinfo	1=Public awareness about climate change 2=Ways of adapting to climate change 3=Ways of mitigating climate change 4=Impact of climate change in Malawi 5=Planting trees, and how to care of trees and the environment 6=Weather and climate forecasts 7=What the government is doing to address climate change 8=Research done/being done on climate change issue 9=Other
17. (a). Assessing concern about global problems	Q17concernworldPpn	1=Not serious at all 2=Not very serious problems: Increasing world population 3=Somewhat serious 4=Serious 5=Extremely serious
(b). Assessing concern about global problems: Armed conflicts	Q17concernworldArmed	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(c). Assessing concern about global problems: HIV/AIDS	Q17concernworldHIV	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(d). Assessing concern about global problems: Global climate change	Q17concernworldCC	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(e). Assessing concern about global problems: Global economic downturn	Q17concernworldEcon	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious

(f). Assessing concern about global problems: Crime	Q17concernworldCrime	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(g). Assessing concern about global problems: poverty, lack of food & water	Q17concernworldPFW	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(h). Assessing concern about global problems: air pollution	Q17concernworldPollu	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(i). Assessing concern about global problems: the spread of diseases	Q17concernworldDisea	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
18. (a). Assessing concern about Malawi's problems: Rapid population growth	Q18concernMalawiPpn	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(b). Assessing concern about Malawi's problems: HIV/AIDS	Q18concernMalawiHIV	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(c). Assessing concern about Malawi's problems: climate change	Q18concernMalawiCC	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(d). Assessing concern about Malawi's problems: Economic downturn	Q18concernMalawiEcon	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(e). Assessing concern about Malawi's problem's: crime	Q18concernMalawiCrime	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(f). Assessing concern about Malawi's problems: poverty, lack of food & water	Q18concernMalawiPFW	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious

(g). Assessing concern about Malawi's problems: air pollution	Q18concernMalawiPollu	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(h). Assessing concern about Malawi's problems: the spread of diseases	Q18concernMalawiDisea	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
19. (a). Assessing concern about problems to the individual: rapid population growth	Q19concernindivPpn	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(b). Assessing concern about problems to the individual: HIV/AIDS	Q19concernindivHIV	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(c). Assessing concern about problems to the individual: climate change	Q19concernindivCC	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(d). Assessing concern about problems to the individual: economic downturn	Q19concernindivEcon	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(e). Assessing concern about problems to the individual: crime	Q19concernindivCrime	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(f). Assessing concern about problems to the individual: poverty, lack of food & water	Q19concernindivPFW	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(g). Assessing concern about problems to the individual: air pollution	Q19concernindivPollu	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
(h). Assessing concern about problems to the individual: the spread of diseases	Q19concernindivDisea	1=Not serious at all 2=Not very serious 3=Somewhat serious 4=Serious 5=Extremely serious
20. Assessing concern about the negative	Q20concernCCindividual	1=Not at all concerned 2=Not very concerned

impact of climate change on the individual		3=Somewhat concerned	4=Very concerned 5=Don't know
21. Assessing concern about the negative impact of climate change on Malawians	Q21concernCCMalawians	1=Not at all concerned 3=Somewhat concerned	2=Not very concerned 4=Very concerned 5=Don't know
22. Whether action has been taken by the individual to address climate change	Q22actionIndividual1	0=No 1=Yes 2=Don't know	
23. Action taken	Q23actionIndividual2 _Plantedtrees	0=No 1=Yes	
	Q23actionIndividual2 _Raisedawareness	0=No 1=Yes	
	Q23actionIndividual2 _Irrigation	0=No 1=Yes	
	Q23actionIndividual2 _Goodpractices	0=No 1=Yes	
	Q23actionIndividual2 _Changedlifestyle	0=No 1=Yes	
	Q23actionIndividual2 _Other	0=No 1=Yes	
24. Willingness to support the implementation of Malawi's national climate change policy	Q24willingness	1=Not at all willing 2=Not very willing 3=Somewhat willing 4=Moderately willing 5=Very willing	
25. Environmental beliefs and values: Humans were meant to rule over the rest of nature	Q25envirobeliefs1	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree	
Environmental beliefs and values: We need to preserve the environment for future generations	Q25envirobeliefs2	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree	
Psychological distance of climate change: I am uncertain that climate	Q25psychdistance1	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree	

change is happening		
Psychological distance of climate change: The causes of climate change are not known	Q25psychdistance2	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Religious and/or spiritual values: Climate change and its impacts is the will of God	Q25religiousbeliefs1	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Accurate knowledge: Humans are to a large extent responsible for climate change	Q25accuknow1	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Psychological distance of climate change: The seriousness of climate change is exaggerated	Q25psychdistance3	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Psychological distance of climate change: There is nothing I can do to slow down the effects of climate change	Q25psychdistance4	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Accurate knowledge: countries should take the blame for climate change	Q25accuknow2	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree Developed 4=Agree 5=Strongly agree
Psychological distance of climate change: It is already too late to do anything about climate change	Q25psychdistance5	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Psychological distance of climate change: My local area is likely to be affected by climate change	Q25psychdistance6	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree

Psychological distance of climate change: Climate change will mostly affect areas that are far away from here	Q25psychdistance7	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Psychological distance of climate change: Climate change is likely to affect mostly developed countries	Q25psychdistance8	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Influence of local geophysical variables: Changes in daily temperature of this area make me believe that climate change is happening	Q25geophysical1	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Psychological distance of climate change: It is uncertain what the effects of climate change will be	Q25psychdistance9	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Religious and/or spiritual values: the solution to the problem of climate change rests with God	Q25religiousbeliefs2	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Psychological distance of climate change: Climate change does not threaten me	Q25psychdistance10	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Accurate knowledge: The concentration of greenhouse gases in the atmosphere leads to changes in climate	Q25accuknow3	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Influence of local geophysical variables: Some catastrophes such as floods and Tsunamis make me believe that climate	Q25geophysical2	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree

change is happening		
Impact of climate change on one's livelihood and perception about climate change: My livelihood has been negatively affected by climate change	Q25livelihood_CCpercept	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
Farming and perceptions about climate change: My farming has been negatively affected by climate change	Q25farming_CCpercept	1=Strongly disagree 2=Disagree 3=Neither agree nor disagree 4=Agree 5=Strongly agree
26. Livelihood: Businessperson	Q26LiveliBus	0=No 1=Yes
Livelihood: Farmer	Q26LiveliFarm	0=No 1=Yes
Livelihood: Fisherman	Q26LiveliFish	0=No 1=Yes
Livelihood: Govt of Malawi employee	Q26LiveliCivil	0=No 1=Yes
Livelihood: Private sector employee	Q26LiveliPriv	0=No 1=Yes
Livelihood: Parastatal employee	Q26LiveliParas	0=No 1=Yes
Livelihood: A casual worker	Q26LiveliPiece	0=No 1=Yes
Livelihood: Other	Q26LiveliOther	0=No 1=Yes
27. Concern about impact of climate change on Malawians' livelihood: Do you think Malawians need to worry about the impact of climate change on their livelihood?	Q27concern_Mlwlivelihood1	1=Definitely No 2=Probably No 3=Probably Yes 4=Definitely Yes 5=Don't know

28. Concern about impact if climate change on the individual's livelihood: How serious do you consider the impact of climate change to be on your livelihood?	Q28concern_Indivlivelihood	1=Not at all serious 2=Slightly serious 3=Somewhat serious 4=Very serious 5=Absolutely serious 6=Don't know
29. Assessing time (in years) when climate change started to affect the individual's livelihood	Q29time_livelihood	1=1 year ago 2=2-3 years ago 3=4-5 years ago 4=6-10 years ago 5=Over 10 years ago 6=Not sure 7=Not applicable
30. Assessing whether the individual has taken action to address impacts of climate change on his/her livelihood	Q30action_livelihood	0=No 1=Yes 2=Not sure
31. Specific action taken to address impacts of climate change on the individual's livelihood	Q31specificaction_livelihood _Plantedtrees	0=No 1=Yes
	Q31specificaction_livelihood _Raisedawareness	0=No 1=Yes
	Q31specificaction_livelihood _Goodpractices	0=No 1=Yes
	Q31specificaction_livelihood _Doingbusiness	0=No 1=Yes
	Q31specificaction_livelihood _Irrigation	0=No 1=Yes
	Q31specificaction_livelihood _Animalfarming	0=No 1=Yes
	Q31specificaction_livelihood _Droughtcrops	0=No 1=Yes
	Q31specificaction_livelihood _Earlycrops	0=No 1=Yes
	Q31specificaction_livelihood _Other	0=No 1=Yes

32. Reason for not taking action to address impacts of climate change on one's livelihood	Q32inaction_livelihood_Lackinformation	0=No 1=Yes
	Q31specificaction_livelihood _Lackresources	0=No 1=Yes
	Q31specificaction_livelihood _Lacksupport	0=No 1=Yes
	Q31specificaction_livelihood _Busywork	0=No 1=Yes
	Q31specificaction_livelihood _Laziness	0=No 1=Yes
	Q31specificaction_livelihood _Impactnotserious	0=No 1=Yes
	Q31specificaction_livelihood _WillofGod	0=No 1=Yes
	Q31specificaction_livelihood _Other	0=No 1=Yes
33. Age group	Q33agegroup	1=18-24 2=25-34 3=35-44 4=45-54 5=55 and older
34. Sex	Q34sex	1=Male 2=Female
35. Ethnicity	Q35ethnicity	1=Chewa 2=Ngoni 3=Lomwe 4=Sena 5=Tonga 6= Tumbuka 7=Nyanja 8=Mang'anja 9=Yao 10=Other
36. Marital status	Q36marital	1=Single (Never married) 2=Married 3=Divorced/Separated 4=Widowed
37. Children	Q37child	0=No 1=Yes
38. Number of children	Q38numberchildren	0=0 1=1 2=2 3=3 4=4 5=5 6=6 7=7 8=8 9=9

39. Nationality	Q39nationality	1=Malawian 2=Non-Malawian
40. Highest level of education	Q40educ	0=Never attended school 1=Primary 2=Junior secondary 3=Senior secondary/GCE 4=A level 5=Professional Certificate 6=Diploma 7=Degree 8=Masters 9=PhD
41. Highest qualification in science-related subject	Q41scienceduc	0=Never attended school 1=Primary 2=Secondary certificate or A Levels 3=University/College Diploma or Degree or Masters
42. Occupation: Farmer	Q42OccupFarmer	0=No 1=Yes
42. Occupation: Fisherman	Q42OccupFish	0=No 1=Yes
42. Occupation: Businessperson	Q2OccupBus	0=No 1=Yes
42. Occupation: Teacher or Lecturer	Q42OccupTeach	0=No 1=Yes
42. Occupation: Manager, banker or other white-collar	Q42OccupWhite	0=No 1=Yes
42. Occupation: Blue collar	Q42OccupBlue	0=No 1=Yes
42. Occupation: Casual worker, pieceworker or labourer	Q42OccupLabourer	0=No 1=Yes
42. Occupation: Church minister or Pastor	Q42OccupChurch	0=No 1=Yes
42. Occupation: Other	Q42OccupOther	0=No 1=Yes

43. Household income per month	Q43income	1=under 15000 2=15001-30000 3=30001-75000 4=75001-100000 5=100001-250000 6=250001-400000 7=over 400000 8=prefer not to say
44. Religion	Q44religion	1= Christian 2=Muslim 3=No religion 4=Other
45. Household members	Q45householdmembers	1=1-3 2=4-6 3=7-9 4=10-12 5=13-15 6=16 and above
46. Political beliefs	Q46politicalbeliefs	1=Conservative 2=Slightly conservative 3=Neutral 4=Slightly liberal 5=Liberal 6=Don't know
47. How often do you attend religious activities?	Q47attendance_religion	1=Never 2=Less than one or twice a year 3=Few times a year 4=Weekly 5=More than weekly
48. Respondents' general comments	Q48generalcomments_studyaddressingCC	0=No 1=Yes
	Q48generalcomments_awareness	0=No 1=Yes
	Q48generalcomments_CChappening	0=No 1=Yes
	Q48generalcomments_govtshouldlead	0=No 1=Yes
	Q48generalcomments_appealforsupport	0=No 1=Yes
	Q48generalcomments_NGOsshouldlead	0=No 1=Yes
	Q48generalcomments_letsholdhands	0=No 1=Yes
	Q48generalcomments_studyenlightening	0=No 1=Yes
	Q48generalcomments_other	0=No 1=Yes

Appendix 4: Multinomial logistic regression analysis results: The causes of climate change are not known

Warnings
There are 51 (47.2%) cells (i.e., dependent variable levels by subpopulations) with zero frequencies.
There is possibly a quasi-complete separation in the data. Either the maximum likelihood estimates do not exist or some parameter estimates are infinite.
The NOMREG procedure continues despite the above warning(s). Subsequent results shown are based on the last iteration. Validity of the model fit is uncertain.
Measures of Monotone Association table is not generated because the dependent variable does not have exactly two levels.

Case Processing Summary

		N	Marginal Percentage
Q25d.Perception_Uncertainty/Scepticism about climate change: The causes of climate change are not known	Disagree	154	57.7%
	Neither agree nor disagree	12	4.5%
	Agree	101	37.8%
Location	Rural	192	71.9%
	Urban	75	28.1%
Q5.Source of information about climate change: Newspaper	No	168	62.9%
	Yes	99	37.1%
Highest level of education	Never attended school or attended only primary school	144	53.9%
	Attended secondary or tertiary education	123	46.1%
Trust in village headman as source	Not trusted	74	27.7%

of climate change information	Trusted	193	72.3%
Q5.Source of information about climate change: School/College/University	No	179	67.0%
	Yes	88	33.0%
Q5.Source of information about climate change: Environmental groups	No	186	69.7%
	Yes	81	30.3%
Valid		267	100.0%
Missing		23	
Total		290	
Subpopulation		36[a]	
a. The dependent variable has only one value observed in 18 (50.0%) subpopulations.			

Likelihood Ratio Tests

Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	116.840	167.062	88.840[a]	.000	0	.
Location_regression	115.567	158.614	91.567	2.726	2	.256
Q5InfosourceNew	113.012	156.059	89.012	.172	2	.918
Education	127.782	170.829	103.782	14.942	2	.001
Trust_villagehead	124.895	167.942	100.895	12.055	2	.002
Q5InfosourceSch	116.641	159.688	92.641	3.801	2	.150
Q5InfosourceEnv	119.396	162.443	95.396	6.555	2	.038

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimates									
Q25d.Perception_Uncertainty/Scepticism about climate change: The causes of climate change are not known[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Neither agree nor disagree	Intercept	-3.457	1.074	10.363	1	.001			
	[Location_regression=0]	-.737	1.196	.380	1	.538	.478	.046	4.990
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceNew=0]	-.398	.960	.172	1	.678	.672	.102	4.412
	[Q5InfosourceNew=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	.626	.851	.541	1	.462	1.869	.353	9.902
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-20.748	.000	.	1	.	.000	.000	.000
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceSch=0]	2.218	1.292	2.949	1	.086	9.193	.731	115.619
	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceEnv=0]	.205	.970	.045	1	.832	1.228	.183	8.226
	[Q5InfosourceEnv=1]	0[b]	.	.	0	.	.	.	.
Agree	Intercept	-2.884	.569	25.714	1	.000			
	[Location_regression=0]	.906	.653	1.927	1	.165	2.476	.689	8.901
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceNew=0]	-.075	.468	.026	1	.873	.928	.371	2.321
	[Q5InfosourceNew=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	1.475	.400	13.593	1	.000	4.373	1.996	9.580
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.736	.393	3.502	1	.061	.479	.222	1.035
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceSch=0]	.208	.493	.178	1	.673	1.231	.468	3.235

	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceEnv=0]	1.189	.479	6.170	1	.013	3.285	1.285	8.396
	[Q5InfosourceEnv=1]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Disagree.									
b. This parameter is set to zero because it is redundant.									

Appendix 5: Multinomial logistic regression analysis results: Climate change and its impact is the will of God

Warnings
There are 20 (30.3%) cells (i.e., dependent variable levels by subpopulations) with zero frequencies.

Case Processing Summary			
		N	Marginal Percentage
25e.Belief about causes of climate change: Climate change and its impact is the will of God	Disagree	106	39.7%
	Neither agree nor disagree	24	9.0%
	Agree	137	51.3%
Location	Rural	192	71.9%
	Urban	75	28.1%
Highest level of education	Never attended school or attended only primary school	144	53.9%
	Attended secondary or tertiary education	123	46.1%
Q5.Source of information about climate change: School/College/University	No	179	67.0%
	Yes	88	33.0%
Q5.Source of information about climate change: Environmental groups	No	186	69.7%
	Yes	81	30.3%
Trust in village headman as source of climate change information	Not trusted	74	27.7%
	Trusted	193	72.3%
Valid		267	100.0%
Missing		23	
Total		290	
Subpopulation		22[a]	
a. The dependent variable has only one value observed in 7 (31.8%) subpopulations.			

Likelihood Ratio Tests						
Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	122.829	165.876	98.829[a]	.000	0	.
Location_regression	131.605	167.477	111.605	12.775	2	.002
Education	126.319	162.191	106.319	7.490	2	.024
Q5InfosourceSch	126.243	162.115	106.243	7.413	2	.025
Q5InfosourceEnv	121.915	157.787	101.915	3.086	2	.214
Trust_villagehead	126.386	162.258	106.386	7.557	2	.023

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimates									
25e.Belief about causes of climate change: Climate change and its impact is the will of God[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Neither agree nor disagree	Intercept	-1.135	.464	5.984	1	.014			
	[Location_regression=0]	-1.331	.744	3.203	1	.073	.264	.062	1.135
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	.387	.757	.262	1	.609	1.473	.334	6.489
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceSch=0]	.466	.658	.501	1	.479	1.594	.439	5.791
	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceEnv=0]	.380	.679	.313	1	.576	1.462	.386	5.538
	[Q5InfosourceEnv=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.908	.530	2.933	1	.087	.403	.143	1.140
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
Agree	Intercept	-1.328	.418	10.074	1	.002			
	[Location_regression=0]	1.177	.505	5.436	1	.020	3.243	1.206	8.721
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	1.034	.379	7.450	1	.006	2.812	1.338	5.908
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceSch=0]	1.229	.462	7.078	1	.008	3.419	1.382	8.458
	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceEnv=0]	-.686	.473	2.104	1	.147	.503	.199	1.273
	[Q5InfosourceEnv=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.899	.366	6.026	1	.014	.407	.199	.834
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Disagree.									
b. This parameter is set to zero because it is redundant.									

Appendix 6: Multinomial logistic regression analysis results: It is uncertain what the effects of climate change will be

Warnings
There are 7 (19.4%) cells (i.e., dependent variable levels by subpopulations) with zero frequencies.
Measures of Monotone Association table is not generated because the dependent variable does not have exactly two levels.

Case Processing Summary

		N	Marginal Percentage
Q25o.Perception_Uncertainty/Scepticism about climate change: It is uncertain what the effects of climate change will be	Disagree	88	33.1%
	Neither agree nor disagree	22	8.3%
	Agree	156	58.6%
Location	Rural	192	72.2%
	Urban	74	27.8%
Highest level of education	Never attended school or attended only primary school	144	54.1%
	Attended secondary or tertiary education	122	45.9%
Trust in village headman as source of climate change information	Not trusted	74	27.8%
	Trusted	192	72.2%
Q5.Source of information about climate change: School/College/University	No	179	67.3%
	Yes	87	32.7%
Valid		266	100.0%
Missing		24	
Total		290	
Subpopulation		12[a]	

a. The dependent variable has only one value observed in 2 (16.7%) subpopulations.

Likelihood Ratio Tests						
Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	85.693	121.528	65.693[a]	.000	0	.
Location_regression	117.477	146.145	101.477	35.784	2	.000
Education	82.568	111.236	66.568	.875	2	.646
Trust_villagehead	82.920	111.588	66.920	1.227	2	.542
Q5InfosourceSch	81.853	110.521	65.853	.160	2	.923

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimates									
Q25o.Perception_Uncertainty/Scepticism about climate change: It is uncertain what the effects of climate change will be[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Neither agree nor disagree	Intercept	-1.191	.463	6.629	1	.010			
	[Location_regression=0]	.090	.781	.013	1	.908	1.095	.237	5.056
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	.181	.779	.054	1	.816	1.199	.260	5.516
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.605	.570	1.125	1	.289	.546	.179	1.670
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceSch=0]	-.162	.565	.083	1	.774	.850	.281	2.573
	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.
Agree	Intercept	-1.497	.420	12.720	1	.000			
	[Location_regression=0]	2.722	.525	26.860	1	.000	15.211	5.434	42.580
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	.392	.421	.869	1	.351	1.480	.649	3.377
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.023	.390	.004	1	.953	.977	.455	2.097
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceSch=0]	-.141	.400	.124	1	.725	.869	.397	1.901
	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Disagree.

b. This parameter is set to zero because it is redundant.

Appendix 7: Multinomial logistic regression analysis results: The solution to the problem of climate change rests with God

Warnings
There are 46 (42.6%) cells (i.e., dependent variable levels by subpopulations) with zero frequencies.
Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.
The NOMREG procedure continues despite the above warning(s). Subsequent results shown are based on the last iteration. Validity of the model fit is uncertain.
Measures of Monotone Association table is not generated because the dependent variable does not have exactly two levels.

Case Processing Summary

		N	Marginal Percentage
25p.Belief about solving climate change: The solution to the problem of climate change rests with God	Disagree	111	41.6%
	Neither agree nor disagree	18	6.7%
	Agree	138	51.7%
Location	Rural	192	71.9%
	Urban	75	28.1%
Q5.Source of information about climate change: Newspaper	No	168	62.9%
	Yes	99	37.1%
Highest level of education	Never attended school or attended only primary school	144	53.9%
	Attended secondary or tertiary education	123	46.1%
Trust in village headman as source of climate change information	Not trusted	74	27.7%
	Trusted	193	72.3%
Q5.Source of information about	No	179	67.0%

climate change: School/College/University	Yes	88	33.0%
Q5.Source of information about climate change: Environmental groups	No	186	69.7%
	Yes	81	30.3%
Valid		267	100.0%
Missing		23	
Total		290	
Subpopulation		36[a]	

a. The dependent variable has only one value observed in 13 (36.1%) subpopulations.

Likelihood Ratio Tests

Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	136.622	186.843	108.622[a]	.000	0	.
Location_regression	158.259	201.306	134.259	25.637	2	.000
Q5InfosourceNew	133.127	176.174	109.127	.506	2	.777
Education	145.209	188.256	121.209	12.587	2	.002
Trust_villagehead	134.256	177.303	110.256	1.634	2	.442
Q5InfosourceSch	134.156	177.203	110.156	1.534	2	.464
Q5InfosourceEnv	133.277	176.324	109.277	.656	2	.720

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimates									
25p.Belief about solving climate change: The solution to the problem of climate change rests with God[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Neither agree nor disagree	Intercept	-1.096	.471	5.428	1	.020			
	[Location_regression=0]	-19.865	.996	397.718	1	.000	.000	.000	.000
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceNew=0]	-.549	.830	.438	1	.508	.578	.114	2.937
	[Q5InfosourceNew=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	18.416	.000	.	1	.	99541721.560	99541721.560	99541721.560
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.473	.557	.720	1	.396	.623	.209	1.857
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceSch=0]	-.181	.766	.056	1	.813	.834	.186	3.742
	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceEnv=0]	.576	.735	.614	1	.433	1.779	.421	7.519
	[Q5InfosourceEnv=1]	0[b]	.	.	0	.	.	.	.
Agree	Intercept	-2.679	.590	20.646	1	.000			
	[Location_regression=0]	2.143	.655	10.697	1	.001	8.522	2.360	30.773
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceNew=0]	.064	.462	.019	1	.890	1.066	.431	2.633
	[Q5InfosourceNew=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	1.226	.366	11.209	1	.001	3.406	1.662	6.981
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.410	.398	1.063	1	.303	.663	.304	1.447
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.

	[Q5InfosourceSch=0]	.585	.490	1.426	1	.232	1.796	.687	4.692
	[Q5InfosourceSch=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceEnv=0]	.132	.464	.081	1	.775	1.141	.460	2.831
	[Q5InfosourceEnv=1]	0[b]	.	.	0	.	.	.	.
a. The reference category is: Disagree.									
b. This parameter is set to zero because it is redundant.									

Appendix 8: Multinomial logistic regression analysis results: My livelihood has been negatively affected by climate change

Warnings
There are 9 (25.0%) cells (i.e., dependent variable levels by subpopulations) with zero frequencies.
Measures of Monotone Association table is not generated because the dependent variable does not have exactly two levels.

Case Processing Summary			
		N	Marginal Percentage
25t.Perception about impact of climate change on one's livelihood: My livelihood has been negatively affected by climate change	Disagree	21	7.9%
	Neither agree nor disagree	33	12.4%
	Agree	213	79.8%
Location	Rural	192	71.9%
	Urban	75	28.1%
Q5.Source of information about climate change: Newspaper	No	168	62.9%
	Yes	99	37.1%
Highest level of education	Never attended school or attended only primary school	144	53.9%
	Attended secondary or tertiary education	123	46.1%
Trust in village headman as source of climate change information	Not trusted	74	27.7%
	Trusted	193	72.3%
Valid		267	100.0%
Missing		23	
Total		290	
Subpopulation		12[a]	
a. The dependent variable has only one value observed in 4 (33.3%) subpopulations.			

Likelihood Ratio Tests						
Effect	Model Fitting Criteria			Likelihood Ratio Tests		
	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	70.406	106.278	50.406[a]	.000	0	.
Location_regression	80.116	108.813	64.116	13.710	2	.001
Q5InfosourceNew	66.854	95.552	50.854	.448	2	.799
Education	68.221	96.919	52.221	1.815	2	.404
Trust_villagehead	69.446	98.144	53.446	3.041	2	.219

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimates									
25t.Perception about impact of climate change on one's livelihood: My livelihood has been negatively affected by climate change[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Neither agree nor disagree	Intercept	1.196	.550	4.736	1	.030			
	[Location_regression=0]	-.184	1.074	.029	1	.864	.832	.101	6.825
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceNew=0]	-.129	.798	.026	1	.872	.879	.184	4.204
	[Q5InfosourceNew=1]	0[b]	.	.	0	.	.	.	.

	[Education=0]	-.875	1.066	.673	1	.412	.417	.052	3.369
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.897	.614	2.131	1	.144	.408	.122	1.360
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.
Agree	Intercept	1.686	.498	11.486	1	.001			
	[Location_regression=0]	1.872	.920	4.143	1	.042	6.503	1.072	39.454
	[Location_regression=1]	0[b]	.	.	0	.	.	.	.
	[Q5InfosourceNew=0]	-.398	.702	.321	1	.571	.672	.170	2.660
	[Q5InfosourceNew=1]	0[b]	.	.	0	.	.	.	.
	[Education=0]	.094	.846	.012	1	.912	1.098	.209	5.771
	[Education=1]	0[b]	.	.	0	.	.	.	.
	[Trust_villagehead=0]	-.888	.523	2.879	1	.090	.412	.148	1.148
	[Trust_villagehead=1]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Disagree.

b. This parameter is set to zero because it is redundant.

Appendix 9: Binary Logistic regression: Personal action to address climate change

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.343	7	.002
	Block	22.343	7	.002
	Model	22.343	7	.002

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	227.855[a]	.111	.152

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.194	7	.867

Contingency Table for Hosmer and Lemeshow Test

		Q22.Have you ever taken any action to address climate change? = No		Q22.Have you ever taken any action to address climate change? = Yes		Total
		Observed	Expected	Observed	Expected	
Step 1	1	8	8.887	5	4.113	13
	2	13	11.038	5	6.962	18
	3	10	10.166	10	9.834	20
	4	9	7.781	9	10.219	18
	5	8	7.794	11	11.206	19
	6	5	5.882	12	11.118	17
	7	10	13.003	34	30.997	44
	8	4	3.402	12	12.598	16
	9	4	3.048	20	20.952	24

Classification Table[a]					
	Observed		Predicted		
			Q22.Have you ever taken any action to address climate change?		Percentage Correct
			No	Yes	
Step 1	Q22.Have you ever taken any action to address climate change?	No	25	46	35.2
		Yes	18	100	84.7
	Overall Percentage				66.1

a. The cut value is .500

Variables in the Equation									
		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	Location_regression(1)	1.327	.589	5.070	1	.024	3.768	1.187	11.957
	Education(1)	-.909	.493	3.402	1	.065	.403	.153	1.059
	Q10BeliefCauseA1(1)	.583	.437	1.786	1	.181	1.792	.762	4.217
	Q5InfosourceNew(1)	.542	.472	1.316	1	.251	1.719	.681	4.337
	Q5InfosourceSch(1)	-.842	.537	2.453	1	.117	.431	.150	1.236
	Q5InfosourceEnv(1)	.376	.473	.631	1	.427	1.456	.576	3.678
	Trust_villagehead(1)	-.837	.385	4.718	1	.030	.433	.204	.922
	Constant	-.208	.553	.141	1	.707	.812		

a. Variable(s) entered on step 1: Location_regression, Education, Q10BeliefCauseA1, Q5InfosourceNew, Q5InfosourceSch, Q5InfosourceEnv, Trust_villagehead.

Appendix 10: Letter of introduction from CREST

crest

Centre for Research
on Evaluation,
Science and Technology

TO WHOM IT MAY CONCERN

RE: Mr Japhet Bakuwa's Data Collection Exercise in Malawi

Sir/Madam, I write to introduce to you Mr Japhet Bakuwa who is a doctoral student here at the Centre for Research on Evaluation, Science and Technology (CREST), Stellenbosch University, Republic of South Africa. Japhet's research project investigates factors that influence public perceptions, attitudes and beliefs about global climate change in Malawi. As a requirement for the research project, Japhet has to verify his hypotheses through field research. It is for this reason that he is in Malawi now to collect data through a questionnaire survey which will be administered to a select group of subjects. Please note that the consent of the participants will be sought and their identities protected. Additionally, there are no known risks for those that will take part in the study.

On behalf of CREST here at Stellenbosch, I will greatly appreciate your permission and assistance towards Mr Bakuwa's data collection exercise.

Sincerely,

Professor Johann Mouton

Director: CREST and the African Doctoral Academy

Appendix 11: Permission letters obtained from District Commissioners and City Councils

crest
Centre for Research
on Evaluation,
Science and Technology

TO WHOM IT MAY CONCERN

RE: Mr Japhet Bakuwa's Data Collection Exercise in Malawi

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On behalf of CREST here at Stellenbosch, I will greatly appreciate your permission and assistance towards Mr Bakuwa's data collection exercise.

Sincerely,

Professor Johann Mouton

Director: CREST and the African Doctoral Academy

TO ALL CHIEFS AND VILLAGE HEADMEN

PLEASE ASSIST MR. JAPHET BAKUWA WHO IS VISITING YOUR VILLAGES IN ORDER TO COLLECT DATA FOR HIS RESEARCH

H C K GONDWE (DPA)

FOR: DISTRICT COMMISSIONER

Commissioner for Oaths
M'mbelwa District Council
07 MAR 2013
P.O. BOX 132, MZIMBA
MALAWI

Sentrum vir Navorsing oor Evaluasie, Wetenskap en Tegnologie • Centre for Research on Evaluation, Science and Technology
Privaat Sak/Private Bag X1 • Matieland, 7602 • Suid-Afrika/South Africa
Tel: +27 21 808 3708 • Faks/Fax: +27 21 808 2023
E-pos/E-mail: crest@sun.ac.za

Telephone: (+265) 01524089
Facsimile: (+265) 01524089

All Communications should be addressed to:
The District Commissioner

In reply please quote REF. No.
ZOMBA DISTRICT COUNCIL
P.O. Box 23, ZOMBA

Ref.No. ZDC/AS/17/1/5

13TH March, 2013

T/A Mwambo
ZOMBA

S/A Nkagula (Kachulu Area)
ZOMBA

Dear Sir/Madam

RE : PERMISSION TO COLLECT DATA TOWARDS ACADEMIC WORK

Reference is made to an introductory letter from Centre for Research on Evaluation, Science and Technology (CREST)_(RSA) on the above captioned subject.

Permission is hereby granted to **Mr. Japhet Bakuwa** to collect data on the **factors that influence public perceptions, attitudes and beliefs about global change in Malawi** – around Kachulu area in T/A Mwambo and STA Nkagula, being a requirement for the doctorial degree research project. The data collection exercise will run up to 31st March, 2013.

The Officer In-Charge, Kachulu Police Unit is being notified of the same.

J L B Chaima
FOR: DISTRICT COMMISSIONER

LILONGWE CITY COUNCIL

CHIEF EXECUTIVE

Ref No. LCA/ADMN/7

P. O. BOX 30396
LILONGWE 3
MALAWI
Tel: (265) 01773144
Fax (265) 01770885

14th March, 2013

TO WHOM IT MAY CONCERN

Dear Sir/Madam

Subject : **PERMISSION TO CONDUCT AN ACADEMIC RESEARCH**

The bearer of this letter is Mr. Japhet Bakuwa, a doctoral student at the Centre for Research on Evaluation, Science and Technology (CREST), Stellenbosch University, Republic of South Africa.

He intends to carry out an academic research within the City on factors influencing public perceptions, attitudes, and beliefs about global climate in Malawi.

The Lilongwe City Council has given Mr. Japhet Bakuwa a go ahead to carry out the research on condition that the information retrieved shall only be used for academic purposes.

The Council therefore requests members of the general public to cooperate accordingly.

Yours faithfully,

RICHARD C.Z HARA
CHIEF EXECUTIVE

ALL CORRESPONDENCE TO BE ADDRESSED TO THE CHIEF EXECUTIVE

P.O. BOX 43
ZOMBA
MALAWI

Your Ref:.......................................

Our Ref: ZCC/ADM/AC/27C

Tel.: (265) 01 525039
Fax.: (265) 01 525 362

20th February, 2013

TO WHOM IT MAY CONCERN

cc : *Police-Officer-In-Charge, Zomba Police Station, P.O. Box 45, Zomba*
: *District Commissioner, Zomba District Council, P.O. Box 23, Zomba*

Dear Sir / Madam,

RE: PERMISSION TO COLLECT DATA TOWARDS ACADEMIC WORK

Reference is made to an introductory letter from Centre for Research on Evaluation, Science and Technology (CREST)- (RSA) on the above captioned subject.

Permission is hereby granted to Mr Japhet Bakuwa to collect data on the **factors that influence public perceptions, attitudes and beliefs about global change in Malawi** - within Zomba City, being a requirement for the doctoral degree research project. The data collection exercise will run up to 31ST March 2013.

The permit is issued under the following conditions:

a) The data collection must be voluntary
b) The data collection is solely for the purpose stated above
c) The permit is only valid for the stated time frame.

The District Commissioner and the Officer-In-Charge are being notified about this development.

AEWP Chima
For: CHIEF EXECUTIVE

ALL CORRESPONDENCE TO BE ADDRESSED TO THE CHIEF EXECUTIVE

crest

Centre for Research on Evaluation, Science and Technology

TO WHOM IT MAY CONCERN

RE: Mr Japhet Bakuwa's Data Collection Exercise in Malawi

Sir/Madam, I write to introduce to you Mr Japhet Bakuwa who is a doctoral student here at the Centre for Research on Evaluation, Science and Technology (CREST), Stellenbosch University, Republic of South Africa. Japhet's research project investigates factors that influence public perceptions, attitudes and beliefs about global climate change in Malawi. As a requirement for the research project, Japhet has to verify his hypotheses through field research. It is for this reason that he is in Malawi now to collect data through a questionnaire survey which will be administered to a select group of subjects. Please note that the consent of the participants will be sought and their identities protected. Additionally, there are no known risks for those that will take part in the study.

On behalf of CREST here at Stellenbosch, I will greatly appreciate your permission and assistance towards Mr Bakuwa's data collection exercise.

Sincerely,

Professor Johann Mouton

Director: CREST and the African Doctoral Academy

DISTRICT COMMISSIONER
MANGOCHI DISTRICT COUNCIL
22nd feb, 2013
PRIVATE BAG 138
MANGOCHI - MALAWI

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Tel: +27 21 808 3708 • Faks/Fax: +27 21 808 2023
E-pos/E-mail: crest@sun.ac.za

Our Ref: KUDC/6/36

Your Ref

DC. Cell: 08 662 828
Tel/Fax: 01 253 314
All replies to be addressed to
The District Commissioner

MINISTRY OF LOCAL GOVERNMENT
& RURAL DEVELOPMENT
KASUNGU DISTRICT COUNCIL

PRIVATE BAG 1, KASUNGU
MALAWI

Date: 6th March, 2013

TO WHOM IT MAY CONCERN

Mr. Japhet Bakuwa of Centre for Research on Evaluation, Science and Technology, Stellenbosch University, Republic of South Africa has been permitted by this office to collect data for his research project.

May you please accord him all the necessary support and assistance.

Yours sincerely,

PP.

E. H. Kaphuka
FOR DISTRICT COMMISSIONER

Kasungu District Council
06 MAR 2013
Director of Administration
Private Bag 1, Kasungu

crest

Centre for Research on Evaluation, Science and Technology

TO WHOM IT MAY CONCERN

RE: Mr Japhet Bakuwa's Data Collection Exercise in Malawi

Sir/Madam, I write to introduce to you Mr Japhet Bakuwa who is a doctoral student here at the Centre for Research on Evaluation, Science and Technology (CREST), Stellenbosch University, Republic of South Africa. Japhet's research project investigates factors that influence public perceptions, attitudes and beliefs about global climate change in Malawi. As a requirement for the research project, Japhet has to verify his hypotheses through field research. It is for this reason that he is in Malawi now to collect data through a questionnaire survey which will be administered to a select group of subjects. Please note that the consent of the participants will be sought and their identities protected. Additionally, there are no known risks for those that will take part in the study.

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Sincerely,

Professor Johann Mouton

Director: CREST and the African Doctoral Academy

TO WHOM IT MAY CONCERN 26/02/13

This is to certify that Mr Bakuwa from the above mentioned Institution, has been given mandate by this office to go ahead in data collection across the district as part of his studies.

Any assistance rendered to him will be highly appreciated.

Kelvin Harawa

Director of Planning & Dev.

DIRECTOR OF PLANNING CHIKHWAWA DISTRICT COUNCIL
25 FEB 2013
P/BAG 1 CHIKHWAWA

Sentrum vir Navorsing oor Evaluasie, Wetenskap en Tegnologie • Centre for Research on Evaluation, Science and Technology
Privaat Sak/Private Bag X1 • Matieland, 7602 • Suid-Afrika/South Africa
Tel: +27 21 808 3708 • Faks/Fax: +27 21 808 2023
E-pos/E-mail: crest@sun.ac.za

crest
Centre for Research
on Evaluation,
Science and Technology

TO WHOM IT MAY CONCERN

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Sincerely,

Professor Johann Mouton

Director: CREST and the African Doctoral Academy

TO WHOM IT MAY CONCERN

Pls assist Mr J. Bakuwa on his assignment.

DC

District Commissioner
Mulanje District Council
[illegible] 5 FEB 2013
Private Bag 9
Mulanje

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E-pos/E-mail: crest@sun.ac.za

Memory Kamoto
DPD

crest

Centre for Research
on Evaluation,
Science and Technology

TO WHOM IT MAY CONCERN

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Centre for Research
on Evaluation,
Science and Technology

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Sincerely,

Professor Johann Mouton

Director: CREST and the African Doctoral Academy

M... ...Y ASSEMBLY
CHIEF EXECUTIVE'S DEPARTMENT
RECEIVED: 08/03/13
REFERED TO:
COMMITTEE:
FILE:

To whom it may concern
Permission Grt.

DIRECTOR OF ADMINISTRATION
MZUZU CITY ASSEMBLY
... 2013
P.O. BOX 1, MZUZU

8/03/13

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